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Organizational technology acceptance and use: a relational perspective

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To my dad,
who taught me to face pain,
to be always strong and determined,
who gave me love and
made me know its essence,
who was a great man, an excellent father,
an irreplaceable model,
who will live inside of me forever.

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ABSTRACT

In the last decades, information technology represents a substantial investment for most corporations and constitutes a significant aspect of organizational work. However, its value is capitalized only when information systems are utilized by their intended users in a manner that contributes to the strategic and operational goals of the firm. Not surprisingly, research on the determinants of individual IT acceptance in organizations is a significant area of inquiry for IS scholars.

In response to this concern, several theoretical models have been proposed to better understand and explain individual attitudes and behaviours toward new IT: innovation diffusion theory, the technology acceptance model, the theory of reasoned action, and the theory of planned behaviour.

The aim of the present study is to analyze the variables that affect the individual attitudes towards technology by considering on one side the traditional perspective and on the other by introducing a new perspective, the relational one, whose premise is that individuals' attitudes towards IT may be influence by the attitude of proximate sources of social information.

Several findings suggest important implication for theory and practice.

CHAPTER 1: INTRODUCTION

The diffusion of information and communication technologies (ICT) has grown increasingly on the last decades, providing companies new opportunities to support their own business activities. Acquire infrastructure, meet legal requirements, provide the tools for the only way of carrying out work at the present time, obtain direct and indirect returns, remain competitive, enable strategic applications are only a few of the several reasons that justify the investments in information technology (Lucas et al., 1999). Far from continuing to be considered an automating and deskilling work, as the industrial paradigm stated (Braverman, 1974), Information Technology (IT) has become a means that enriches work, that, meanwhile, is become firstly an intellectual rather than a manual activity.

ICT are important tools of organizational change. As Daft (2001) stated, organizational change occurs with the adoption of new ideas or behaviours by an organization. It refers to technological change of products and services, strategy and structure, or change of culture. Organizations plan a change aiming for better outcomes; however, not all changes produce positive results because resistance may exist. Successful change involves employees' positive attitudes, which influence in turn the acceptance of the information system (IS).

Although the numerous potential benefits an IT can bring into a firm, many systems fail or are underutilized, making vain the effort, time and money organizations have spent. Therefore, the current researchers interest on technology acceptance and use is due to the consequences of the lack of technology use, the productivity paradox[1] (Sichel, 1997), and to the firm rejection of using technology. Adopting IT to support business needs is clearly a crucial prerequisite because of the opportunities of exploiting the actual potentials of IT. Unfortunately the adoption of IT is a necessary but not a sufficient condition for its effective use. Organizations make primary adoption decisions, yet it is

[1] Despite the enormous IT investment, there isn't a productivity increase.

individuals within the firm who are the ultimate users and consumers of IT. It is evident that true business value from any information technology would derive only through appropriate use by its target user group. Therefore, firms need to maximize ICT use, avoiding individual resistance to changes that obstructs performance improvements tied to IT introduction, thus reducing the gap between ICT potentials and its actual use.

Not surprisingly, in spite of the existence of mature research in social studies, covering many fields from information system, psychology, sociology to organization science, research on the determinants of individual IT acceptance in organizations continues to be a significant area of inquiry for IS scholars (Lewis et al., 2003, Agarwal, 2000).

This topic has been studied from different perspectives, including the diffusion of innovation, technology acceptance model, social cognitive theory, theory of planned behaviour, and theory of reasoned action (Compeau et al., 1999). Otherwise, less emphasis has been placed to investigate the different social determinants of technology acceptance from a relational perspective. In literature many models have been developed to understand the influential elements of technology acceptance, as this is a theme of interest both to researchers in a variety of fields as well as procurers of technology for large organizations. Moreover, research on technology adoption has been studied both at an individual and at a group and organizational level (Leonard-Barton and Deschamps, 1988).

The studies on the variables affecting the acceptance of technology by individuals started since IS introduction into organizations. In 1983 Rogers, with his theory of Diffusion of Innovation, was the first who tried to predict whether and how a new invention would have been successful.

In the innovation adoption and organisational science literature, Technology Acceptance Model, evolving from the Theory of Reasoned Action (Ajzen & Fishbein, 1975) and the Theory of Planned Behaviour (Ajzen, 1985), seems to be the most influential and most frequently discussed theory in predicting and explaining end user behaviour and system

use in the information system field, perhaps because of its parsimony and the wealth of empirical support. It became a reference point for all the following studies, whose main objective was to introduce new variables and test them.

According to Venkatesh et al. (2007), technology adoption studies have reached a mature stage, and there is an emerging need of identifying and developing a new set of future research directions in this area. The aim of the present study is to contribute to these weaknesses.

Despite the interesting outcomes achieved by technology acceptance models, and their aptitude to be generalized across a wide range of technologies and settings, there is a call for alternative theoretical perspectives. This need evolves from one of the main limits identified by researchers in previous works: the lack of an investigation on the effect of user's communication patterns on acceptance. In fact, in TAM, in its referent theories and in its evolutions, it was included a variable called social influence. But this variable was only based on a construct called "subjective norms", that on one hand has received little attention in the context of TAM research, on the other doesn't explain in depth the real significance of the term social influence as it is conceived by researchers in social and organizational fields.

Indeed, previous studies investigating the social determinants on individual beliefs take a normative framework for defining the relationship between the focal individual and the source of influence, considering others' expectation as the source of social influence (Magni and Pennarola, 2008). Therefore, social relationships between users and organizational entities are seen from a normative perspective, which contains the explicit or implicit notion that individuals are influenced "by the way in which they think that others will view them as a result of having used the technology" (Venkatesh et al., 2003).

On the contrary, individuals are embedded in a network of larger social processes, which they influence and which also influence them (Granovetter, 1985). All forms of mutual

interactions involve mutual influence processes and these function at several levels, cognitive, interpersonal, and cultural. Further, influence is frequently indirect rather than direct. Others influence us in ways we are not even aware of, and influence shapes not only our behaviour but also our thoughts, memories and cognitive representations (Forgas et al., 2001). Therefore, organizations can also be conceptualized as social systems in which interaction contributes to shared symbols and meanings among system members. This conceptualization leads to social explanations of information technology attitudes and behaviours that emphasize the influence of social forces and the symbolic meaning conveyed by the choice of a system in a particular social setting.

The aim of this research is to combine those perspectives to develop a unified and more complete model that embodies the variables that could influence the acceptance and use of an organizational information system by focusing at individual level and by considering also influences of the group of reference.

User acceptance is defined as "the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support" (Dillon & Morris, 1996), while IT use is simply the utilization of information technology by individuals, groups or organizations (Straub et al., 1995). Obviously there will be always a degree of deviation of actual use from idealized, planned usage, but the essence of acceptance theory is that such deviations are not significant; that is, the process of user acceptance of any information technology for intended purposes can be modelled and predicted (Dillon & Morris, 1996).

I assume with Davis (1989) that individual behaviours depend on two main construct: perceived usefulness and perceived ease of use. Then I suppose that these two attitudes towards technology are influence by four classes of variables that are grouped as follow:

- Individual variables,
- Institutional variables,
- Social variables,

- Relational variables.

While the first three classes combine those items that have showed a high significance in previous literature, the last one is new in the field of information systems.

The premise for the consideration of this variable is the evaluation that people are not always rational in selecting and using technologies, and attitudes towards and use of IS are influenced by culture, norms, social context, salient others (Fulk et al. 1992, Rice and Love, 1987). Salancik and Pfeffer's Social Information Processing Model states that individuals may be influenced by cues from others about what to attend to, how to value the salient dimensions of workplace phenomena, and how to evaluate the same phenomena. In this regard, when people collaborate with others using technology, exposure to social information may lead to change in attitude. On the other hand, Festinger's theory of social comparison states that uncertainty forces people to communicate with others, and in this communication they tend to evaluate and compare themselves and their attitudes and behaviours with reference others. This mechanism is similar to that explained by contagion theories, according to which networks would infect attitude and behaviour of its members.

My goal is to analyze the variables that affect the individual attitudes towards technology by introducing a new perspective, the relational one. In particular, the present study aims at studying, together with the traditional sources of influence, if relational beliefs regarding users and other organizational workers affect individuals' acceptance of a technology, influencing both perceived usefulness and ease of use.

In order to accomplish this goal I tested the hypothesis of the model into an Italian multinational telecommunication company, focusing on a sample of 97 SAP users. This system is mandatory into the company and for this reason, unlike previous studies that considered the intention to use the system, as dependent variable I used what I consider a good proxy of individual technology acceptance: the intention to improve the SAP knowledge.

SAP is an Enterprise Resource Planning system that aims to provide integrated software to handle multiple corporate functions including finance, human resources, manufacturing, materials management, and sales and distribution. The adoption of these systems by the business world has been touted as one of the most important developments in the corporate use of IT in the 1990s. They require significant organizational resources and their implementation is inherently risky due to large investments required. Thus, SAP represents a good chance not only for testing my model but also for studying one of the most complex and challenging system.

Two different kind of analysis were used to estimate the model and to have homogeneous data: social network analysis, used to translate relational data into attributional, one and to study how nodes interact reciprocally, and structural equation modelling.

1.1 Contribution of the research

The characteristics of today's competitive environment put a great deal of pressure upon organizations for greater levels of organizational integration. The geographical expansion of competition and markets that are increasingly global create a greater need to integrate operations around the world. In addition, many of today's customers increasingly expect products to fit their specific needs, as well as requiring faster delivery times. However, achieving higher levels of organizational integration appears to be far from being simple and easy. An important contribution of the present research is to help the understanding of ERP phenomenon, whose research is still in its early stages (Klaus et al., 2000), and needs to be grounded in theory (Barki, 2002). It can be considered as an inquiry into the variables that can affect its acceptance among organizations and that can make easier, more effective, and faster its implementation.

Moreover, even though the TAM model has been tested across a wide range of computer settings and has been shown to be a robust predictor of computer use (Taylor & Todd,

1995; Venkatesh & Davis, 2000), a better understanding of the factors that influence perceived usefulness and perceived ease-of-use must be taken into account. Further, many researchers have stated that mandatory setting need additional study.

Finally relational perspective is new in this field of research and it seems to show great potential, by explaining network-based mechanisms whereby individuals' attitudes towards information technology may be influenced by the attitudes of proximate sources of social information. Social influence plays a crucial role in human behaviour and decision making and my attempt to investigate in depth this variable, by considering not only subjective norms but also informal and indirect persuasion, could be a starting point to overcome the weaknesses of previous research.

1.2 Structure

I organize my argument as follows. In the next section I provide a review of the models developed in literature to identify variables affecting individual acceptance of technology (section 2.1).

Following this, I will introduce the relational perspective by focusing on the main theories explaining the social influences processes that shape individual attitudes and behaviour (section 2.2) and on the social network approach (section2.3).

The research hypotheses are introduced in section 3, while the research methodology is explained in section 4. The latter includes: the context and a brief description of ERP systems (section 4.1 and 4.2), the sample of analysis (sections 4.3), the data collection (section 4.4), the data analysis (sections 4.5) and the variables' building (section 4.6). The fifth section is entirely dedicated to the presentation of the statistical results. I conclude this work with a general discussion of its limits and a number of implications for the future research (section 6).

CHAPTER 2: THEORETICAL BACKGROUND

2.1 The traditional perspective

2.1.1 Attitude-behaviour theories

For many decades, social psychologists have attempted to influence people's attitude to predict behaviours. The most fundamental assumption underlying the attitude concept is the notion that attitudes guide, influence, direct, shape, or predict actual behaviour (Ajzen & Fishbein, 1974; Gross & Niman, 1975; Kraus, 1995). Thus, with few exceptions, the assumption that attitude is useful for predicting behaviour went unchallenged until the 1960s (Ajzen & Fishbein, 1980). According to Fishbein and Ajzen conceptual framework (1973), it is possible to distinguish between four components: beliefs, attitudes, intentions and behaviour.

A person's attitudes are believed to form in response to the acquisition of certain *beliefs*. Fishbein and Ajzen (1975) posit that people may acquire beliefs on the basis of direct observation, or information received from outside sources, or by way of various inference processes. Therefore, the attitude concept can be viewed as a set of beliefs, each belief can be thought of as a separate attribute, and a person's overall attitude toward the object is a function of his or her evaluations of those attributes. Different people may have similar beliefs about various objects but may give them quite different evaluative weights. Thus, similar beliefs may result in different attitudes, depending on the different evaluative weights given.

Fishbein and Ajzen (1975) introduced the idea of corresponding measures of *attitude* and behaviour. They argue that the attitude to an object is not necessarily related to the attitude to behaviour towards that object, and that researchers' failure to recognise this attitudinal distinction has led to inaccuracies in behavioural predictions[2]. Hence, correlations between attitude to the object and action toward that object may not be high.

[2] For example, someone may have a very favourable attitude towards a political party (the object), but not be inclined to vote at the next election (the behaviour towards the object).

Therefore, Ajzen (1988) suggests if it is the action toward the behaviour a researcher wishes to predict, it is the attitude towards performing this action that needs to be measured.

For many years researchers assumed that the relationship between attitude and behaviour was direct[3]. However, Ajzen and Fishbein (1980) disputed this assumption, and argued that attempts to predict behaviour simply by measuring attitudes will not succeed. Within Ajzen and Fishbein's conceptual framework, attitude is viewed as one major determinant of the person's *intention* to perform the behaviour in question. However, other beliefs are also considered to be relevant for the formation of behavioural intentions (Ajzen & Fishbein, 1970). Normative beliefs are those that occur due to other people's influence on whether an individual should or should not perform the behaviour in question. In addition to attitude and normative beliefs, Ajzen (1985) acknowledged that the formation of intentions to act may also be influenced by aspects that are not under a person's volitional control, such as the requirement of certain abilities, or necessary resources. For this reason, the concept of a person's perceived ability to act, should he or she want to, was later included in Ajzen and Fishbein's conceptual framework, to account for situations where behaviour is not considered to be under a person's voluntary control.

Ajzen and Fishbein view behavioural intentions as the immediate antecedents of corresponding overt behaviours; hence, the best prediction of behaviour is a person's intention to perform the *behaviour*. The apparent simplicity of this approach is somewhat deceptive, however. Fishbein and Ajzen (1975) assert there are two factors that can disrupt the intention-behaviour relationship. The first is the intervening time between the stated intentions and the actual time of the act. Since it is often impractical to measure a person's intention immediately prior to performance of the behaviour, the measure of intention obtained at one time may not be representative of the person's

[3] The more favourable the attitude, the more likely someone is to behave in accordance with that attitude, with no other variables intervening the relationship.

intention at the time of the behavioural observation. This is due to the fact that behavioural intentions are affected by many situational factors, which may intervene and disrupt the attitude-behaviour relationship. In turn this leads to a situation where behavioural intentions do not correspond well with actual behaviour. For instance, if a person states an intention to buy a car in three months time, any change in his or her financial position, the price of the car, or the availability or price of petrol may influence that stated intention. A second factor that Fishbein and Ajzen (1975) suggest causes problems in attitude-intention-behaviour measurement is described as the degree of compatibility in levels of specificity. That is, an intention can only provide an accurate measure of a predicted behaviour if there is compatibility in what exactly is being measured. Therefore, Fishbein and Ajzen state it is important that the measures of attitude and intention that are obtained are at the same level of specificity as the behaviour they are trying to predict, in order to match cause and effect. That is, the more precise the behavioural intention which is obtained, the more likely it is to be accurately related to the subsequent behaviour.

2.1.2 Technology acceptance theories

Because of its 18 years of research in the field of information system, the technology acceptance model doesn't maintain its original structure but has evolved and has made progress (Lee et al., 2003). According to Lee et al., it is possible to divide its progress into four periods: introduction, validation, extension, and elaboration.

After the introduction of information systems into organizations, technology acceptance and use received extensive attention (Rogers, 1983; Kwon and Zmud, 1987; Swanson, 1988). In 1983 Rogers developed the broad social psychological/sociological theory called *Diffusion of Innovations Theory*. It purports to describe the patterns of adoption, explain the mechanism, and assist in predicting whether and how a new invention will be successful. It is concerned with the manner in which a new technological idea,

artefact or technique, or a new use of an old one, migrates from creation to use. According to Diffusion of Innovation theory, technological innovation is communicated through particular channels, over time, among the members of a social system. The stages through which a technological innovation passes are: knowledge (exposure to its existence, and understanding of its functions); persuasion (the forming of a favourable attitude to it); decision (commitment to its adoption); implementation (putting it to use); and confirmation (reinforcement based on positive outcomes from it). Rogers demonstrates that relative advantage, compatibility, complexity, trialability and observability are correlated with the adoption of innovations. Relative advantage is defined as the degree a new innovation surpasses current practices, while compatibility is the extent that an innovation is perceived to be consistent with the adopters' existing values, past experiences and needs. Complexity refers to the perceived difficulty of learning to use and understand a new system or technology and trialability is the degree to which an innovation can be experimented with or used on a trial basis. Observability refers to the extent that the results of an innovation are easily seen and understood.

Each of these characteristics on its own is insufficient to predict either the extent or the rate of diffusion, but diffusion studies have demonstrated that innovations affording advantages, compatibility with existing practices and beliefs, low complexity, potential trialability, ad observability, will be more extensively and rapidly diffused that an innovation with the cluster of the opposite characteristics.

In examining and extending these characteristics in a context specific to information technology, Moore and Benbasat (1991) report an extensive effort to develop an instrument which can be used to evaluate user perceptions of IT innovation. Their results suggest that the most important perceived characteristics of an IT innovation which affect decisions regarding use are: voluntariness of use, image[4], relative advantage, compatibility, ease of use, trialability, result demonstrability, and visibility.

[4] The degree to which the use of an innovation is perceived to enhance one's image or status in one's social system.

While diffusion theory provides a context in which one may examine the uptake and impact of information technology over time, it provides little explicit treatment of user acceptance. Its most direct link would appear to be in the area of innovation characteristics that may drive individual adoption decisions and innovation positioning.

Conversely, researchers in the fields of human-computer interaction and management information systems have drawn heavily on theoretical work in social and cognitive psychology, as well as sociology, in studying user acceptance.

As stated above, TAM evolved from theories in the field of social psychology, (the Theory of Reasoned Action and the Theory of Planned Behaviour).

Theory of Reasoned Action (TRA) was developed by Ajzen and Fishbein's in 1975. It suggests that a person's behavioural intention depends on the person's attitude toward behaviour and subjective norms.

Behavioural intention (BI) is a measure of the strength of an individual to perform a specified behaviour. Attitude (A) is the individual's positive or negative feelings to perform the behaviour. It consists of beliefs about the consequences of performing the behaviour (b_i) multiplied by his or her evaluation of these consequences (e_i).

$$A = \sum b_i \, e_i$$

Beliefs are defined as the individual's subjective probability that performing the target behaviour will result in consequence *i* (Davis et al., 1989). The evaluation term refers to "an implicit evaluative response" to the consequence *i* (Fishbein and Ajzen, 1975). The A equation represents an information-processing view of attitude formation and change which posits that external stimuli influence attitudes only indirectly through changes in the person's belief structure.

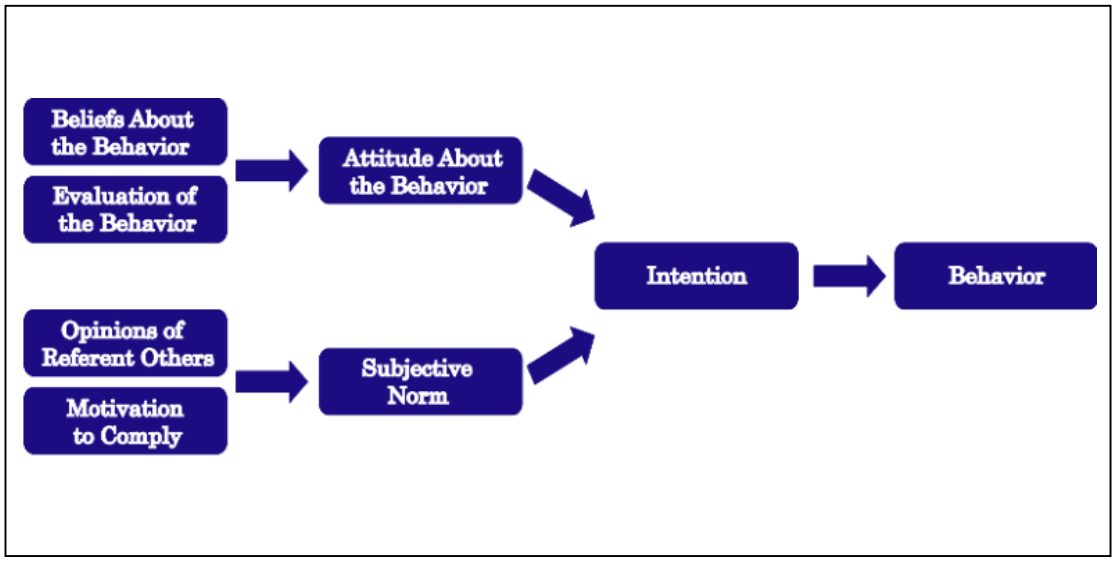
Subjective norm (SN) is seen as a combination of perceived expectations from relevant individuals or groups along with intentions to comply with these expectations. In other words, "the person's perception that most people who are important to him or her think

he should or should not perform the behaviour in question". It is determined by a multiplicative function of his or her normative beliefs (n_ib_i) and his or her motivation to comply (mc_i) with these expectations (Fishbein and Ajzen, 1975).

$$SN = \sum nb_i\, mc_i$$

TRA is a general model that doesn't specify the beliefs that are operative for a particular behaviour. It asserts that any factor that influence behaviour do so only indirectly, by influencing A, SN or their relative weights. Ajzen and Fishbein's model has been adapted for use in many fields and much of their research backs up there assumptions which is why it is so widely used in academia and business today.

Figure 1: Theory of Reasoned Action



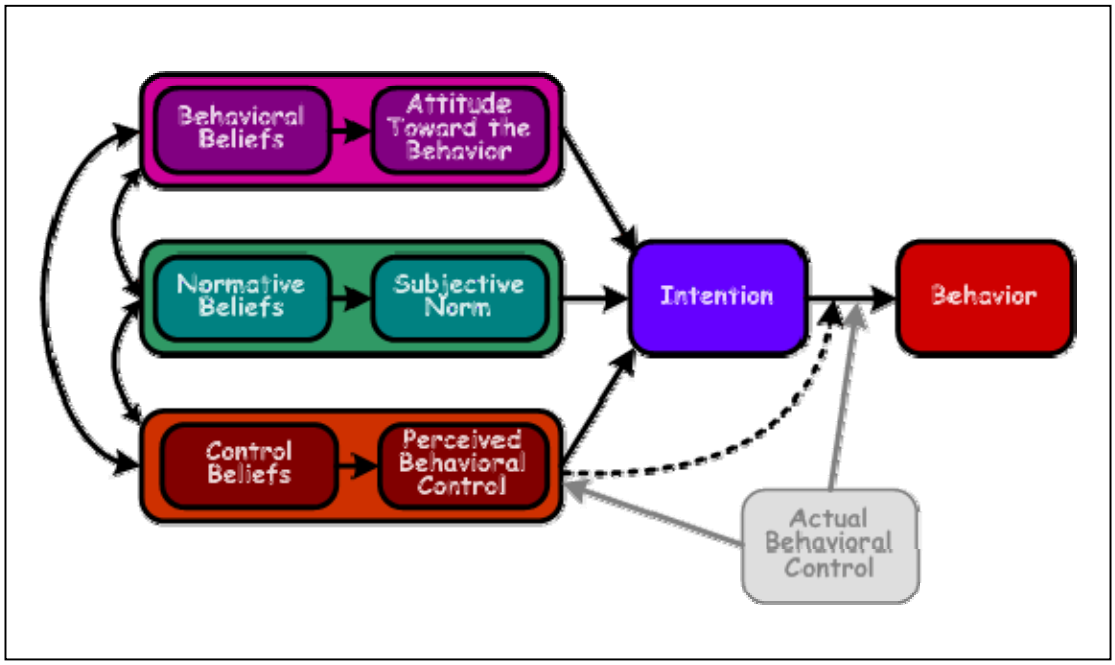
Source: Ajzen and Fishbein (1975)

Fishbein and Ajzen have long asserted that their model can be used to understand and predict most human behaviour. However, in their meta-analysis examining the application of TRA, Sheppard et al. (1988) found that more than half of the research to date that has utilized the model has investigated activities for which the model was not originally intended. Although their expectation was that the Fishbein and Ajzen model would fare poorly in such situations, they found that the model performed extremely

well in the prediction of goals and in the prediction of activities involving an explicit choice among alternatives. Thus, it would seem that the Fishbein and Ajzen model has strong predictive utility, even when utilized to investigate situations and activities that do not fall within the boundary conditions originally specified for the model. That is not to say, however, that further modifications and refinements are unnecessary, especially when the model is extended to goal and choice domains.

The *Theory of Planned Behaviour* is developed by Ajzen in 1985 as an extension of the Theory of Reasoned Action, because of limitations' of the previous model in dealing with behaviours over which people have incomplete volitional control.

Figure 2: Theory of Planned Behaviour



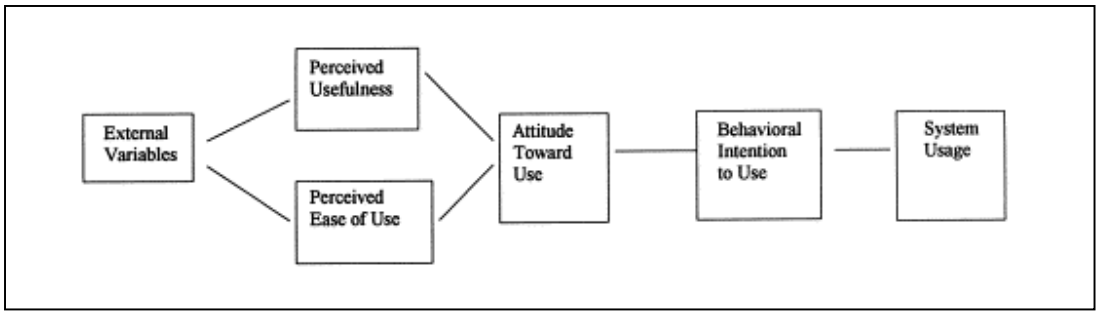
Source: Ajzen (1985)

As the TRA, this model considers the individual's intention as a central factor in performing a given behaviour. It also postulates three independent determinants of intention: attitude towards the behaviour, subjective norms, and perceived behavioural

control. The attitude towards the behaviour refers to the degree to which a person has a favourable or an unfavourable evaluation or appraisal of the behaviour in question. Subjective norm refers to the perceived social pressure to perform or not to perform the behaviour. The third new variable is the perceived behavioural control which refers to the perceived ease or difficulty of performing the behaviour and it is assumed to reflect past experience as well as anticipated impediments and obstacles. Perceived behavioural control originates from Bandura's (1977) concept of perceived self-efficacy which "is concerned with judgment of how well one can execute courses of action required to deal with perspective situations".

Technology acceptance model (TAM) is an adaptation of TRA specifically tailored for modelling user acceptance of information systems. It was developed by Davis in 1989 with the goal of provide an explanation of the determinants of computer acceptance, "while being both parsimonious and theoretically justified" (Davis et al., 1989) at the same time. In 10 years it has become well-established as a robust and powerful model for predicting user acceptance.

Figure 3: Technology Acceptance Model



Source: Davis et al. (1989)

While theorizing this model, Davis recognized the validity of two variables among the numerous that can influence system use. By identifying a striking convergence among a body of theoretical perspectives in the fields of expectancy theory, self-efficacy theory (Bandura, 1982), behavioural decision theory, diffusion of innovations (Tornatzky and

Klein, 1982), marketing (Hauser and Simmie, 1981) and human computer interaction (Branscomb and Thomas, 1984), he considered *perceived usefulness* and *perceived ease of use* as fundamental determinants of user acceptance.

According to him, people decide to use a system only if they believe it will help them to better perform their job. At the same time this benefit can be outweighed by the perception that the system is too hard to use. Davis defined perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance", and perceived ease of use as "the degree to which a person believes that using a particular system would be free of effort".

TAM theorises that the effects of external variables (e.g., system characteristics, development process, training) on intention to use are mediated by perceived usefulness and perceive ease of use. According to it, perceived usefulness is also influenced by perceived ease of use because, other things being equal, the easier the system is to use the more useful it can be.

After the introduction period, researchers performed several TAM studies mainly focused on two streams:

1. the first attempted to replicate TAM with other technologies, longitudinal situations, and research settings, to verify whether it is a parsimonious model;
2. the other stream compared TAM and its origin, TRA and TPB, to investigate whether TAM can be differentiated from TRA, and whether TAM is superior to TRA.

Several replication studies appeared in the following period (Adams et al., 1992, Davis, 1993, Davis et al., 1989, Hendrickson, Massey & Cronan, 1993, Sambamurthy and Chin, 1994, Segars & Grover, 1993, Szajna, 1994, Subramanian, 1994), and it was found that TAM could successfully predict IS acceptance behaviour under different technologies and different situations. In addition, it was found that TAM was a much

simpler, easier to use, and more powerful model of the determinant of user acceptance of computer technology than TRA (Igbaria et al. 1997).

Researchers tried also to differentiate TAM from TRA. Davis et al. (1989) compared TRA and TAM in how they measure an MBA student's relative facility with a word processor across two time periods—immediately after introducing the system and 14 weeks later. They found that TAM better explained the acceptance intention of the users than TRA. Hubona and Cheney (1994) compared both TAM and TPB model and found that TAM offers a slight empirical advantage and is a much simpler, easier to use, and more powerful model to explain users' technology acceptance.

During the so called validation period, researchers started a validation of TAM's original instruments (Adams et al., 1992, Hendrickson et al., 1993, 1996, Segars and Grover, 1993, Chin and Todd, 1995, Szajna, 1994, Davis and Venkatesh, 1996), to confirm that TAM truly uses an accurate measurement of the user's acceptance behaviour under different technologies, situations, and tasks (Lee et al., 2003).

After validation efforts confirmed the saliency of the measurement instruments, prolific expansion efforts began to introduce new variables postulating diversified relationships between constructs and the search for antecedents (or external) variables of the major TAM constructs, PU and PEOU, in an attempt to identify boundary conditions.

One distinctive feature of TAM studies in this period was to attempt model extension with external variables which include individual, organizational, and task characteristics. For instance, Agarwal and Prasad (1999) extended TAM with five kinds of individual difference variables as the external variables of PU and PEOU. They found that the relationship between participation in training and PU, between prior experiences, role with regard to technology, tenure in workplace, level of education, and prior experience and PEOU, were predicted successfully. Igbaria et al. (1995) investigated the effects of organizational factors and found that user training, computing support, and managerial support significantly affect both PU/PEOU and microcomputer usage. Karahanna and

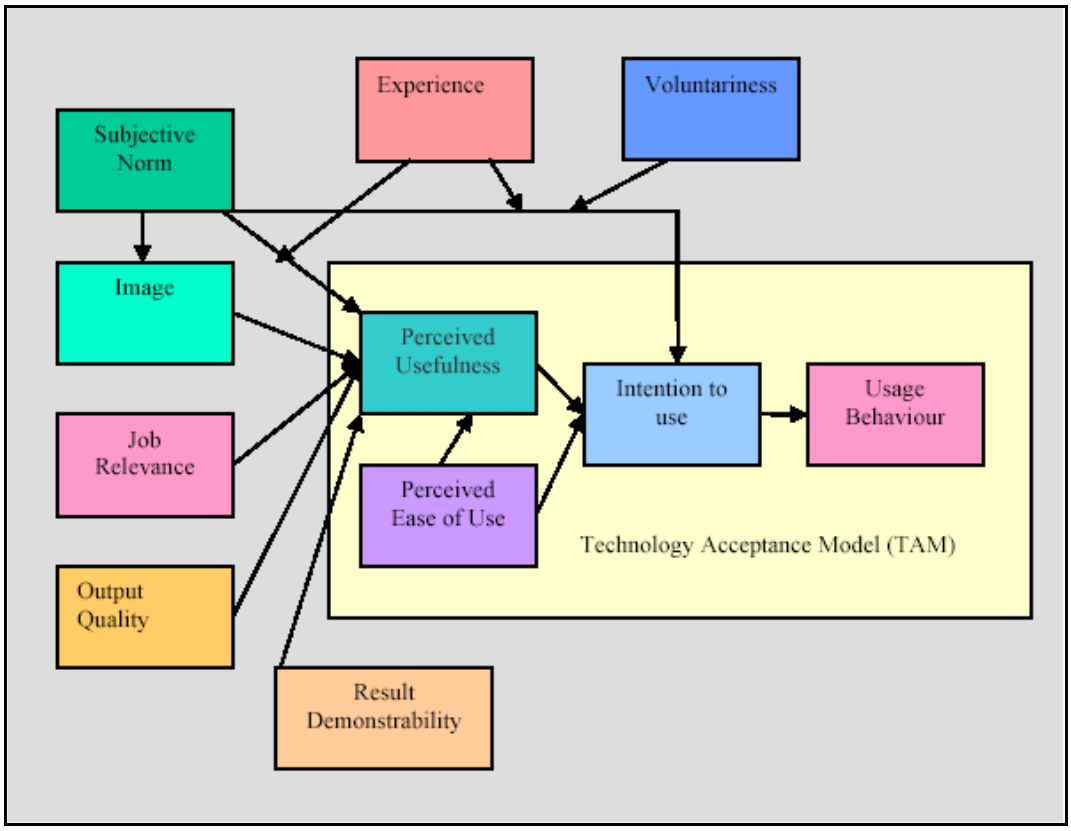
Limayem (2000) conducted a study with two technologies, e-mail and voice-mail, and found that the determinants of the system usage and those of PU and PEOU are different among the technologies. PU did not influence e-mail usage but social influence did, and the result was reversed in the case of voice-mail.

Another effort in the extension period was to identify and investigate TAM's boundary conditions. As suggested by Adams et al. (1992), the moderating effects for TAM variables such as culture, gender, task, user type, and IS type needed to be examined. For example, Straub (1994) applied the TAM model in two countries with different cultures, and found that culture played an important role in the attitude toward and choice of communication media. He found that Japanese workers perceived fax to be more useful than did U.S. workers, but in the case of e-mail, the perception was reversed. Gefen and Straub (1997) also investigated the effect of gender difference on IS acceptance, and determined that gender significantly moderates the effects of PU, PEOU, and social presence. They found that men are more affected by PU, while women are more affected by PEOU and Subjective Norm.

Finally, during the elaboration period there was an effort to develop the next generation TAM that synthesizes the previous effects and to resolve the limitations raised by previous studies.

In 2000 Venkatesh and Davis developed an extension of TAM to include additional determinants of TAM's perceived usefulness and usage intention constructs, given the less consistent effects *perceived ease of use* has exhibited across studies, and to understand how the effects of these determinants change with increasing user experience over time with the target system. This model was referred to as *TAM2* and was tested using longitudinal data collected regarding four different systems at four organizations. The authors consider additional theoretical construct spanning social influences processes and cognitive determinants.

Figure 4: TAM2



Source: Venkatesh and Davis (2000)

Among social forces they include subjective norms, voluntariness, and image. TAM2 encompasses three main theoretical mechanisms by which subjective norms can influence *intention* directly and indirectly through *perceived usefulness*: compliance, internalization and identification.

Compliance refers to that mechanism by which people may choose to perform behaviour, even if they are not themselves favourable toward the behaviour or its consequence, if they believe one or more important referents think they should, and they are sufficiently motivated to comply with the referents. TAM2 illustrates that this direct effect will occur only in mandatory, but non voluntary, system usage settings. To

distinguish between mandatory and voluntary settings the model posits voluntariness as a moderating variable.

Internalization refers to the process by which, when one perceived that an important referent thinks one should use a system, one incorporates the referent's belief into one's own believe structure. In the case of internalization, subjective norms have an indirect effect on *intention* through *perceived usefulness*, and this effect occurs both in a voluntary and in mandatory settings.

Identification, in accordance with Kelman (1958), refers to a situation in which if important person's social group at work believes that he or she should perform behaviour, then performing it will tend to evaluate his or her standing within the group. This effect is captured in TAM2 by the effect of subjective norm on image, coupled with the effect of image on perceived usefulness.

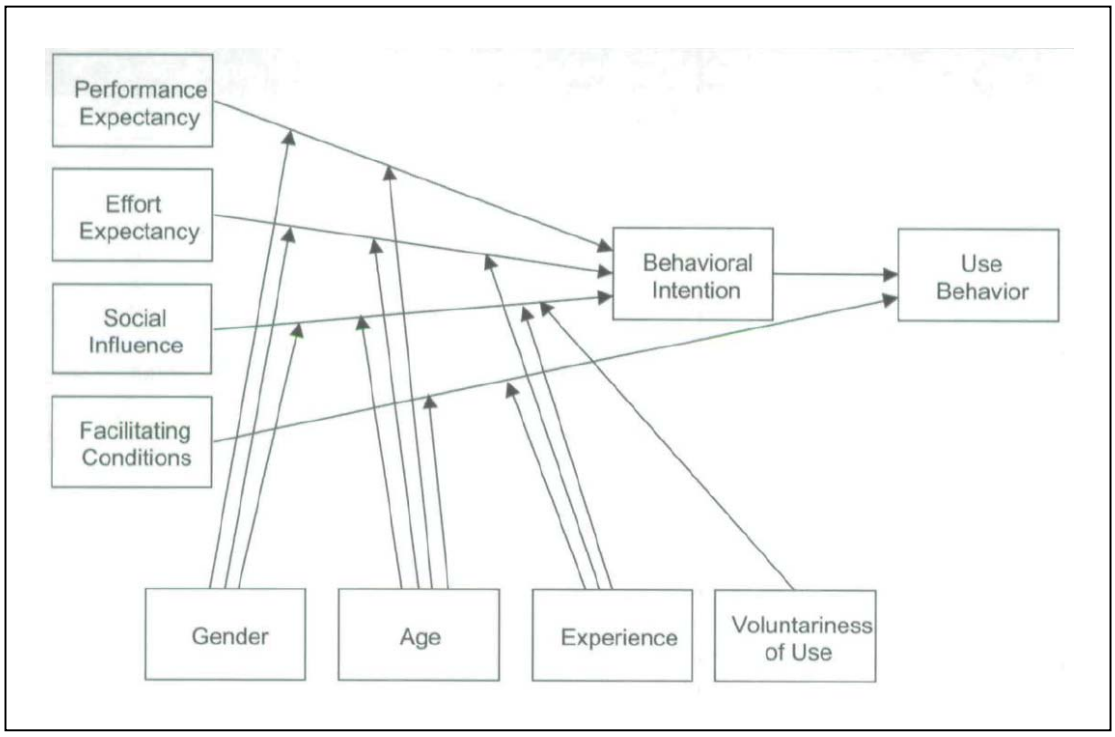
According to Venkatesh and Davis (2000), the direct effect of subjective norm on intentions and the indirect effect through perceived usefulness may subside over time with increased system experience. The interpretation of this pattern is that, before a system is developed, users' knowledge and beliefs about the system are "vague and ill-formed" (Hartwick and Barki, 1994), and people must rely on the opinion of others as a basis for their interpretation. After implementation, when more about the system's strengths and weaknesses are known through direct experience, the normative influence subsides.

Beyond the social influence processes the authors theorise four cognitive determinants of perceived usefulness: job relevance, output quality, result demonstrability, and perceived ease of use. While perceived ease of use is a concept retain from TAM, job relevance is considered a function of the importance within one's job of the set of tasks the system is capable of supporting, output quality refers to how well the system performs the task, and finally result demonstrability is defined by Moore and Benbasat (1991) as the "tangibility of the result of using the innovation".

This model was strongly supported by analysis and represents an important contribution to theory by extending TAM to address causal antecedent of one of its constructs, perceived usefulness.

Finally in 2003 Venkatesh et al. formulated the *Unified Theory of Acceptance and Use* of Technology (UTAUT), based upon conceptual and empirical similarities across eight prominent models they had validated and compared, with the aim of integrating fragmented theory and research into a unified theoretical model that captures the essential elements considered in previous researches. This model were Theory of Reasoned Action, Technology Acceptance model, Motivational Model, Theory of Planned Behaviour, a combination of TAM and TPB, Model of PC Utilization, Innovation Diffusion Theory, an Social Cognitive Theory. This model theorized that four constructs play a significant role as direct determinants of user acceptance and usage behaviour: performance expectancy, effort expectancy, social influence and facilitating conditions.

Figure 5: UTAUT



Source: Venkatesh et al. (2003)

Tests provided a strong empirical support of UTAUT, which posits three direct determinants of intention to use (performance expectancy, effort expectancy, and social influence) and two direct determinants of usage behaviour (intention and facilitating conditions). The effects of these four variables on the intention to use and user behaviour are moderated by age, gender, voluntariness and experience.

From the preceding literature, many well-known theories and models have been used as a theoretical base by a large number of researchers. Despite the specific advantages of each theory, the capability of the theory/model in predicting and explaining behaviour is measured by the extent to which the predictors in the theory could account for a reasonable proportion of the variance in intention and usage behaviour. The more the predictors could account for the variance in behaviour, the greater the strength of the model in predicting and explaining the behaviour intention and usage behaviour.

There are different positions regarding the state of art of this area of inquiry. Venkatesh et al (2007) stated that due to the parsimony of TAM, and the robustness of its scales, an excessive focus on replication can hinder progress both in the area of technology adoption and in information systems in general. It doesn't mean that research on individual-level technology adoption is died but this is only a suggestion to turn on new research directions, focusing on interventions, contingencies, and alternative theoretical perspectives.

On the other hand Lewis et al. (2003), recognizing the dominant role TAM played in the last twenty years and by conducting a meta-analysis to investigate the homogeneity of the relations between the components used in TAM, concluded that this model can explain only about 40% of system's use. This led the authors suggesting that significant factors are not included in the models, so that it must be integrated into a broader one which includes more and new variables.

With the present study we want to overcome one of the main limits of the previous works that considered with less emphasis the importance of social norms and the social relations as determinants of technology acceptance and use.

In the next paragraph the focus is on the relational perspective, considering the importance of others in the creation of ones own behaviour and beliefs.

2.2 The relational perspective

The literature review, discussed above, shows how previous studies investigating the influence of social determinants on individual beliefs take a *normative* framework for defining the relationship between the focal individual and the source of influence, considering others' expectations as the primary source of social influence.

The *normative approach* (Agarwal, 2000) is based upon the "person's perception that most people who are important to her think she should or should not perform the behaviour in question" (Fishbein and Ajzen, 1975). Thus, implicitly, it arises that "social sanction" is the concept through which individuals attitudes and behaviours are influenced (Venkatesh et al., 2003).

As stated by Magni & Pennarola (2008) prior research on acceptance has not adequately recognized the importance of those individuals' beliefs, which refer to the exchange *relationships* between users and other intra-organizational entities. According to Clarkson (1995), *relationships* are the first conditions of human being and represent critical determinants of individual actions in organizations, affecting the connection between objective characteristics of a definite organizational situation and individual behaviours (Brief & Weiss, 2002).

Into organizations people are involved in a net of relationships that can influence their behaviour. According to this assumption and considering the aim of the present study, as unit of analysis it must be taken into consideration not only the individual himself, but

also the relationships he/she has with others not only from a normative perspective (Everett and Bhowmik, 1970).

Several authors have addressed the impact of *social influence* on the development of attitudes and behaviours (Berger & Luckmann, 1967; Festinger, 1954; Salancik & Pfeffer, 1978; Burkhardt, 1994). Although research has established a relationship between attitudes and social influence, there is still little empirical evidence to imply this causality, or that social context affects attitudes and behaviours. They have suggested that individuals develop attitudes and behaviours in part as a result of the social information available to them.

Through relationships with others, a focal employee may be exposed to new information and different points of view. Accordingly, the expectation of most social influence studies is that individuals who maintain relationships with one another will have greater interpersonal similarity with respect to perceptions or attitudes than will individuals who do not interact with one another (Coleman et al., 1966; Festinger, 1954; Friedkin, 1993; Festinger, Schacter, & Bach, 1950; Homans, 1950). Social influence occurs when an individual adapts his or her behaviour, attitudes or beliefs to the behaviour, attitudes or beliefs of others in the social system (Leenders, 1997). Influence does not necessarily require face-to-face interaction, but is based on information about other people. Social influence may arise when individuals affect others' behaviours, or when individuals imitate the behaviours of others, irrespective of the intention of the behaviour's originator (Marsden & Friedkin, 1994).

Festinger (1954) developed a theory of social comparison processes to describe how individuals come to share attitudes, proposing that people have an innate drive to evaluate themselves and their attitudes and behaviours and that they select similar others with whom to compare themselves. He states that because of the absence of certain judgments and physical evidence, people are encouraged to communicate with others. He also suggests that they tend to relate to people similar to themselves so that "the

more similar someone is, the more relevant his or her view for understanding one's own world".

One of the most obvious principles of human communication is that the exchange of messages most frequently occurs between at source and a receiver who are similar, homophilous. As stated by McPherson et al. (2001) "similarity breeds connection". *Homophily* refers to the degree two pairs are similar with respect to certain attributes. In a free-choice situation, when a source can interact with anyone of a number of different receivers, there is a strong tendency for him to select a receiver like himself (Rogers and Bhowmik, 1970), that is contacts among similar occurs at a higher rate than among dissimilar people. Empirical evidence of the homophily principle is available from studies of a great variety of communication situations. According to theories of homophily, communication is effective when the transfer of an idea from a source to a receiver results in a change of knowledge, attitude, or overt behaviour on the part of the receiver. When the source or receiver share common meanings, attitudes, and beliefs, and a mutual code, communication between them is likely to be more effective. Heterophilic interaction is likely to cause message distortion, delay transmission, restriction of communication channels, and may cause cognitive dissonance, and uncomfortable psychological state, as the receiver is exposed to messages that may be inconsistent with his existing beliefs and attitudes. These assumptions can be reversed in the implied time-order of antecedent and consequent, so that interaction leads to homophilization.

Lazarsfeld & Merton (1954) distinguished two types of homophily: *status homophily*, in which similarity is based on informal, formal, or ascribed status and *value homophily*, which is based on values, attitudes and beliefs.

Status homophily includes characteristics like race ethnicity, sex or age, and religion, education, occupation, or behavioural patterns. *Value homophily* includes the wide variety of internal states presumed to shape our orientation toward future behaviour.

Social influence processes have also been termed contagion (Leenders, 1997). *Contagion theories* seek to explain networks as conduits for "infectious" attitude and behaviour (Monge & Contractor, 2003). These theories are based on the assumption that the opportunities for contact provided by communication networks serve as a mechanism that exposes people, group, and organizations to information, attitudinal messages, and the behaviour of others (Burt, 1980; Contractor & Eisenberg, 1990). This exposure increases the likelihood that network members will develop beliefs, assumptions, and attitudes that are similar to those of others (Carley, 1991; Carley and Kaufer, 1993).

Contagion mechanisms have been used to explain network members' attitudes as well as behaviour. In its primitive form, contagion mechanisms seek to explain a focal person's attributes, based on the attributes of other people in the network and the relations through which these other individuals' attributes "infect" the attributes of the focal person. The actors in the network may be individuals, groups, organizations, industries, associations, nations, and so on. Assuming that the focal person is *i* and each other person is *j*, that each actor *i* has attributes $A1_i$, $A2_i$, and so on, a contagion mechanism, and that the relations from actor *i* and actor *j* are $R1_{ij}$, $R2_{ij}$ and so on, a contagion mechanism would propose that the value of a focal person's attribute, $A1_i$, is contagiously influenced by the values of the attribute, $A1_j$, of other people in the network. Further, the extent to which the focal person is influenced by each other actor's attribute[5] is determined by the strength of the focal person *i*'s relation $R1_{ij}$, with each of the other actors, *j*.

The contagion mechanism can be represented as:

$$A1_i = \text{function } [\Sigma(R1_{ij})(A1_j)]$$

[5] The attributes if the actors may be their attributes, behaviours, or other practices.

Where the value of an attribute for person *i* is contagiously influenced by the sum of the value if the attribute $A1_i$ for each other person j weighted by person *i*'s relation $R1_{ij}$ with actor *j*.

Theories that are premised on a contagion model include *social information processing* (Fulk et. al. 1987; Salancik and Pfeffer, 1978).

Building on the works of Festinger (1954) and others, Salancik and Pfeffer (1978) developed the *social information processing theory*, whose premise is that individuals, as complex adaptive systems, adapt their attitudes, behaviours, and beliefs to the social context and to the consequences of past experiences and actions. Therefore to study an individual behaviour it is necessary to understand the social environment and the setting in which he/she is involved. Individuals develop their needs and their opinions since the information they have at a given time.

The social context has two effects on one's attitude and needs: on one hand, it provides a construction of meaning, through the development of common beliefs, needs and acceptable reasons of actions (the direct effects), on the other it focuses an individual's attention on certain information, shading the others (the indirect effects). Therefore the environment is created by individual and by social processes.

Gallivan et al. (2005) apply the social information processing approach to the discipline that studies the variables that affect the information system acceptance and use. They stated that the previous literature had failed in suggesting the user training as the main ingredient for successful implementation of information systems. On the contrary, they suggest that the learning process is not an individual one but it results from a social phenomenon. The user training is neither necessary nor a sufficient facilitating condition of IT usage. It is rather a group level process deeply embedded in doing; it is "part of ongoing work within a specific social context that is shaped by group and organizational level forces" (Wenger, 1998). Quoting the cognitive psychology, Gallivan et al. state that individuals learn better when there is a social component to learning, trough a self-

discovery or help from peers, without following training instructions. They assert that despite several researchers have examined the importance of social influence and subjective norms in assessing users' beliefs about an innovation, results in this area have been inconsistent. They believe that the problem is conceptual and methodological. It is conceptual because they didn't consider the distinction, made by Fulk (1993) between compliance and internalization; it is methodological because they didn't collect relevant data in a manner that was consistent with the social network method employed by Fulk or Rice et al. (1991).

According to these authors (Rice and Aydin, 1991), central on the social information processing theory is the assumption that individuals must be proximate to the attitudes, information, or behaviour of others to be exposed to social information (Salancik and Pfeffer, 1978; Dean and Brass, 1985). Proximity is defined as the extent to which one could be exposed to social information in a given social system (Rice and Aydin, 1991).

But according to them social influence theories, including social information processing theory, fail to provide explicit guidance as to how indentify and weight the relevant source other, operationalize different proximity mechanisms of social influence, or specify different levels of analysis.

On the contrary *Networks* provide the mechanisms by which individuals are proximate to, or are exposed to, others' information, influence, and behaviour, through three proximity mechanisms: relational, positional, and spatial.

In the *relational view*, an organization is a *communication network* in which actors or subunits repeatedly interact as they process resources and information (Dow, 1988), constructing purposes, goals, and attitudes. Thus, the influence mechanism from the relational view is communication proximity, or the extent to which individuals interact directly and indirectly (Rogers and Kincaid, 1981). A relational model of social influence is based on the proposition that people are most likely to compare with and come to agree with others to whom they are more strongly tied. This approach presumes

that it is not just the specific others with whom one communicates that must be taken into account, but also the strength of that communication.

In the *positional network view*, individuals occupy the same position, or are structurally proximate, to the extent that they occupy the same roles and thus set of obligations, status, and expectations (Burt, 1980). Two kinds of underlying relationships can be conceptualized in an organizational context: structural equivalence and organizational proximity. Adherents of the structural equivalence approach to proximity argue that two individuals may have similar attitudes, not necessarily because they are linked with each other (as with relational proximity) but because they are linked to similar others, have experienced similar socialization, and are similarly unlinked to the remaining sets of others (Burt, 1980). From an organizational structure perspective, a position can be conceptualized as the configuration of horizontally and vertically differentiated job positions, which represent patterns of instrumental relations among the positions (Dow, 1988). Such organizational structures provide the channels for information and control among functionally interdependent tasks created by the division of labour (Lincoln and Miller, 1979). More generally, organizational structure mediates the purpose and direction of information and influence, such as in influencing employee reactions to their jobs (Oldham and Hackman, 1981) and employee perceptions of their communication relationships (Corman, 1990).

Spatial proximity, the third potential mechanism for social information processing, may be intentional, such as when office landscaping and physical structures are used to place individuals with similar tasks together, or may result from less conscious factors, such as common obstacles, accessible stairwells, floorspace, or client flow. Simply living or working close to one another increases the likelihood of interaction and thus exposure to social information and others' attitudes. Spatial proximity may also affect social information processing not directly through communication interaction but through exposure to or inaccessibility of other individuals, organizational sub climates and events, task materials, private spheres of activity, and aspects of the workplace

(Hackman, 1983). These mechanisms show different and stronger effects as we go through the spatial proximity, positional proximity and relational proximity, because of the increase of direct contacts and consequently the rice of the variety and repetition of information.

Because networks represent the mechanism through which individuals' are proximate to others' information and beliefs, much of empirical evidence of relational influence has been studied through the network perspective.

2.2.1 Social network approach

Social network analysis has been widely adopted and used for the study of SIPM, or SIM (Burkhardt, 1994; Burkhardt & Brass, 1990; Rice & Adyn, 1991). In the present study, I will also assess social information processing with social network analysis.

Network approach, in fact, embraces a distinctive perspective that focuses on relations among actors, whether they are individuals, work units, or organizations.

According to the network perspective, actors are embedded within networks of interconnected relationships that provide opportunities for and constraints on behaviour. This perspective differs from traditional perspectives in organizational studies that examine individual actors in isolation.

The difference is the focus on relations rather than attributes, on structured patterns of interaction rather than isolated individual actors.

Social network analysis is an approach and set of techniques used to study the exchange of resources among social entities (i.e., individuals, groups, or organizations) (Wasserman and Faust, 1994). The resources exchanged can be of many types, including tangibles such as goods, services, or money, or intangibles such as information, social support, or influence. Each relationship refers to a particular type of resource exchange.

It is the intersection of relationships that defines an individual's centrality in a group, a group's role in an organization (White, Boorman, & Breiger, 1976), or an organization's niche in a market (McPherson, 1983).

A network is a set of nodes and the set of ties representing some relationship, or lack of relationship, between the nodes. I refer to the nodes as actors (individuals, work units, or organizations). The particular content of the relationships represented by the ties is limited only by a researcher's imagination.

Information relationships indicate what kinds of information are being exchanged, between whom, and to what extent. The pattern of relationships between actors reveals the likelihood that individuals will be exposed to particular kinds of information, and the likelihood of their considering that data to be authoritative. Patterns of forwarding and receipt describe networks that show how information moves around an environment, and how actors are positioned to facilitate or control the information flow.

Using this network perspective, organizational researchers have been able to explain variance in such traditional organizational *outcomes* as individual satisfaction, performance, and job exit, group structure and performance, and organizational innovation and survival (Brass et. al, 2004). Network patterns emerge, become routine, and both constrain and facilitate behaviour. Attitudes and behaviours change as a result of networks.

Theory and research have also noted that, just as similar actors are prone to interact, those who interact become more *similar*. People are not born with their attitudes, nor do they develop them in isolation; attitude formation and change occur primarily through social interaction (Erickson, 1988). As people seek to make sense of reality, they compare their own perceptions with those of others.

Another consequence of interpersonal networks is *job satisfaction*. Despite contradictory evidences, researchers (Roberts and O'Really, 1979; Morris, 2002) have found that

relative isolates (people with zero or one link) in an organization's communication network were less satisfied than participants (those with more links).

Moreover, *power*, as a natural consequence of a central network position, has been the topic of much research (Brass, 1984; Brass and Burkhardt, 1993; Krackhardt, 1988). Theoretically, actors in central network positions have greater access to, and potential control over relevant resources, such as information in a communication network. Actors who are able to control relevant resources and thereby increase others' dependence on themselves acquire power. In addition, actors must also decrease their dependence on others. They must have access to relevant resources that are not controlled or mediated by others.

Networks are valuable also in *job search* and *recruitment*, particularly for high-paying, high-responsibility jobs such as managerial positions. Previous studies have shown that people find jobs more effectively through weak ties (acquaintances) than through strong ties (friends) or formal listings (Granovetter, 1982; Wegener, 1991). An actor, relating to his own friends, has access only to redundant information. Thus individuals have greater access to more and different job opportunities when relying on weak ties.

Finally, relationships with others affect both *performance*, especially if those contacts involve the ability to acquire necessary information and expertise, and *getting ahead* in organization, due to the importance of social capital and the presence of structural holes (Burt, 1992), that let an actor to gain no redundant information as well as to be in a position of control of information.

Likewise, research has focused on the *antecedents* of networks. As stated above, similar people tend to interact with one another. *Similarity* is thought to ease communication, increase the predictability of behaviour, and foster trust and reciprocity. The same happens with *personality* that can affect social interaction. If similarity and personality implies that interactions within organizations are voluntary, *organizational structure* shapes networks in organizations. Formally differentiated positions locate individuals

and groups in physical space and at particular points in an organization work flow and hierarchy of authority, thereby restricting their opportunity to interact with some others and facilitating interaction with still others. Because it would be difficult for a superior and subordinate directly linked by a formal hierarchy to avoid interacting, it would not be surprising for an "informal" social network to shadow the formal hierarchy of authority.

Social network researchers also consider the *content* of relationships that exist between individuals because different types of relationships, or ties, can be more or less influential (Friedkin, 1993; Ho, Levesque, & Rousseau, 2006).

Burt (2000) refers to "network content" as "the substance of relationships, qualities defined by distinctions such as friendship versus business versus authority". "Others" refers to "attributes of the nodes" with respect to their self reported knowledge (Rodan & Galunic, 2004). Monge & Eisenberg (1987) propose a grouping of the contents in social networks into the following typology: expression of affect, influence attempt, exchange of information, and exchange of goods and services. A taxonomy directly linking to the division between formal and social networks together with the corporate culture is proposed by Tichy & Tushman (1979): technical content which encompasses work related issues, political content relating to individual and group goals, and cultural content, that reaches into the implicit, tacit and deeper meanings and shared values in the organization. Another division has been introduced by Krackhardt & Hanson (1993). They argue that the most useful division in order to perform successful analyses on the social network is to consider the advice network that can be used to determine who has the technical or professional power in an organization, the trust relations which reveal ties of friendship and affection, whereas the communication network is a strong indicator of the overall information flow in the organization.

Studies examining tie content not only distinguish different network types, indicating the kind of relationships linking proximate actors, but also consider the sources of power that accrue to more centrality actors. We can make a distinction between the

instrumental network links that arise in the course of work role performance and expressive network relations that primarily provide friendship and social support (Tichy et al., 1979; Lincoln & Miller, 1979). Friendship ties tend to be stronger, more intimate links, tend to connect people who are similar on a variety of personal characteristics (Marsden, 1988) and involve more frequent interaction (Krackhardt & Porter, 1986; Krackhardt & Stern, 1988; Krackhardt, 1990). Instrumental links, by contrast, tend to be weaker ties linking people who differ in personal characteristics and/or in their positions in the vertical and horizontal division of labour or in access to scarce resources (Lincoln, 1982; Lin, 1981).

This difference has several implications for the transmittal of social influence. First, according to social comparison theory, only people who are similar or have convergent interests are useful comparison points. Friendship ties tend to develop between people who are similar on a variety of personal characteristics, including gender, race, age, and religion (Marsden, 1988; Ibarra, 1992) and are also highly affected by propinquity, such that dense friendship networks tend to develop within organizational subunits and departments (Krackhardt & Stern, 1988). Consequently, friendship ties are more likely than instrumental ties to link people who are similar with respect to both personal characteristics and organizational affiliations and who are thus more likely to have consistent interests. Second, friendship ties also tend to be characterized by more frequent interaction than other types of ties (Granovetter, 1973; Krackhardt and Porter, 1986), providing greater repetition of information and increasing the opportunity for the transmission of social cues (Salancik and Pfeffer, 1978). Finally, due to their strength and concomitant pressures for conformity, expressive links carry greater potential for persuasion and influence (Rogers and Kincaid, 1981; Granovetter, 1982; Krackhardt, 1992). Information obtained from friends thus may be more credible or relevant, more easily or frequently available, and more persuasive or influential (Brass et al. 1992).

CHAPTER 3: HYPOTESIS

The present study adopts the theoretical framework presented by Lewis et al. (2003) in which the individual's belief about technology is considered as influenced by three dominant sources of influence: institutional influences, social influences, and individual factors.

In accordance with the main objective of this work, that is to overcome the main limits of the previous technology acceptance models which didn't consider or considered not adequately all the antecedent of technology usefulness and ease of use, a fourth variable will be introduced, the relational variable.

3.1 Outcomes in technology acceptance

In a review and synthesis of the IS implementation literature, DeLone and McLean (1992) suggested that system success is a multifaceted construct comprised of six different, yet related, outcomes. In addition to quality measures (system and information quality), these outcomes include an attitudinal measure (user satisfaction), performance related measures (individual and organizational impacts) and a behaviour (system use).

System quality refers to reliability of the computer system, on-lie response time, the ease of terminal use, system accuracy, and investment utilization (Swanson, 1974; Alloway, 1980; Emery, 1971; Hamilton and Chervany, 1981). Information quality focuses, on the other hand, on the quality of the system output. It includes information accuracy, output timeliness, reliability, completeness, relevance precision and currency (Larcker and Lessig, 1980; Bailey and Pearson, 1983, Ahituv, 1980, Olson and Lucas, 1982). Measures of system use comprise actual use or recorded amount of user connect time. There are also different levels of use or adoption. For instance Vanlommel and DeBrabander (1975) proposed four levels of use: use for getting instructions, use for recording data, use for control, and use for planning. When the use of an information

system is required, the preceding measures become less useful; and successful interaction by management with the information system can be measured in terms of user satisfaction. User satisfaction or user information satisfaction is probably the most widely used single measure of IS success. Studies have found that it is associated with user attitudes toward computer systems (Igerhseim 1976; Lucas 1978) so that user-satisfaction measures may be biased by user computer attitudes. Of all the measures of I/S success, "impact" is probably the most difficult to define and it is closely related to performance and so "improving my - or my department's – performance" is certainly evidence that the information system has had a positive impact. However, "impact" could also be an indication that an information system has given the user a better understanding of the decision context, has improved his or her decision-making productivity, has produced a change in user activity, or has changed the decision maker's perception of the importance or usefulness of the information system. Finally, with reference to organizational performance, Lucas and Nielsen (1980) measured participant performance (and thus, indirectly, organizational performance) in terms of profits in a logistics management game while Chervany, Dickson, and Kozar (1972) chose cost reductions as their dependent variable. Several researchers have also suggested that the success of the MIS department is reflected in the extent to which the computer is applied to critical or major problem areas of the firm (Garrity 1963; Couger and Wergin 1974; Ein-Dor and Segev 1978; Rockart 1979; Senn and Gibson 1981), others considered the return on investment.

The present study focuses on user satisfaction by considering the interaction of the information product with its recipient, the IS user. This satisfaction is evaluated as the intention of users to deepen their knowledge of the technology system. This work is the first one to examine the construct "intention to improve knowledge", aiming at studying the individual attitudes to improve the knowledge and consequently to have a more effective use of the system. The intention to use, analysed by previous studies, can be assimilated to the intention to improve knowledge about the system. I assume that the

intention of individuals to deepen knowledge about the system can be a good proxy of the future use of it. A positive behaviour toward the system, by showing the need to understand in depth the systems features, can be considered as a "demonstrable willingness to employ information technology for the task it is designed to support"[6] and thus a good measure of the system acceptance into organization.

3.2 Perceived usefulness and perceived easy of use

Technology acceptance models suggest that the influence of all the variables on technology acceptance outcomes is mediated by individual beliefs about technology use. These beliefs are identified in perceived usefulness and perceived ease of use.

Perceived usefulness (PU), together with perceived ease of use (PEOU), is the most accepted variable used to explain user acceptance of information technology. The term perceived usefulness was first coined by Davis (1989), while analysing the importance of the support evaluation a technology offers in the performance one's job. According to Davis, "people tend to use or not to use an application to the extent they believe it will help them perform the job better".

The concept of perceived ease of use derives from the definition of "ease": "freedom from difficulty or great effort". As stated by Davis (1989), effort is a finite resource that must be allocated to various activities. Lower is the effort expectancy on using a given information system, higher will be the intention to use it by a potential user.

According to these concepts and with TAM and its evolutions, I can say that an individual behavioural intention to improve knowledge of a system is determined by two beliefs, perceived usefulness and perceived easy of use. Therefore, consistent with the theoretical arguments underlying TAM (Davis et al. 1989), it is also hypothesised a direct impact of perceived ease of use on perceived usefulness.

[6] This is the definition of user acceptance as stated by Dillon and Morris (1996).

H1: *Perceived usefulness has a significant influence on intention to improve knowledge of the system.*

H2: *Perceived ease of use has a significant influence on intention to improve knowledge of the system.*

H3: *Perceived usefulness has a direct influence on perceived ease of use.*

3.3 Individual factors

In previous research, the factors that have received consistent support as predictors of users' influence on an individual's cognitive interpretations of information technology are computer self-efficacy and personal innovativeness (Lewis et al., 2003).

Self efficacy, that is an individual's self-confidence in his/her ability to perform a behaviour, has its theoretical roots in Bandura's (1977) social cognitive theory and it is defined as the conviction that one can successfully execute the behaviour required to perform the desired outcome.

In subsequent work, IS researchers have found that self-efficacy tailored to an information technology context is an important determinant of a variety of user perceptions of technologies. Venkatesh and Davis (1996) and Agarwal et al. (2000) posited and found empirical support for a significant relationship between general computer self-efficacy beliefs and perceptions about the ease of use of a specific technology. Taylor and Todd (1995b) stated in TPB that self-efficacy was a significant determinant of perceived behavioural control, and also a significant determinant of behaviour both in intention and usage.

Self-efficacy has also been proposed and has accumulated empirical support as an important antecedent of perceived usefulness. Drawing upon Bandura's {1977) social cognitive theory, Compeau and Higgins {1995a, 1995b) and Compeau et al. {1999)

posited that self-efficacy would exhibit a positive influence on individual expectancies about the consequences of performing a specific behaviour.

Whereas several individual difference variables could potentially affect how individuals respond to innovations, personal innovativeness as a construct that is important to the study of individual behaviour toward innovations has had a long-standing tradition in innovation diffusion research in general (Rogers 1983, 1995).

According to Agarwal and Prasad (1998) it has implications for both theory and practice. From the perspective of practice, personal innovativeness helps identify individuals who are likely to adopt information technology innovations earlier than others. Such individuals can then serve as key change agents and opinion leaders to facilitate further diffusion of a new technology (Rogers 1995). From a theoretical perspective, the inclusion of personal innovativeness furthers our understanding of this process by explicating the role of individual traits in technology adoption.

In the aim of the present study, personal innovativeness would help us to further understand both how perceptions are formed and the subsequent role they play in the formation of individual behaviours. Rogers and Shoemaker (1971) and Rogers (1995) conceptualize this construct in terms of its operational definition, i.e., individuals are characterized as "innovative" if they are early to adopt an innovation. However, this definition has been criticized because it does not allow for prediction and subsequent management intervention[7]. As a result, researchers in marketing have noted that it is important to conceptually and operationally draw a distinction between global innovativeness and domain specific innovativeness (Flynn and Goldsmith 1993). The notion of global innovativeness was hypothesized as a personality trait that is possessed by all individuals to a greater or lesser degree. Domain-specific innovativeness, on the other hand, is posited to exhibit significant influence on behaviours within a narrow domain of activity (Goldsmith and Hofacker 1991).

[7] Innovativeness is measured after decision to adopt the innovation has already been made.

Agarwal and Prasad (1998), focusing attention on domain-specific as opposed to global innovativeness, defined personal innovativeness as "the willingness of an individual to try out any new information technology" and conceptualized it as a trait, a relatively stable descriptor of individuals that is invariant across situational considerations.

Drawing upon Rogers' theory of the diffusion of innovations, they argue that individuals develop beliefs about new technologies by synthesizing information from a variety of channels, including mass media and interpersonal channels. For the same exposure to different types of channels, individuals with higher personal innovativeness are expected to develop more positive beliefs about the target technology.

Based on the studies cited above, coupled with the predominant findings from previous theoretical and empirical research, which suggest that individual characteristics influence information system usage via their effects on beliefs I hypothesize that this construct can affect both perceived usefulness and perceived ease of use.

Based on these considerations, I can suggest that:

H4a: *Computer self-efficacy has a significant positive influence on individual beliefs about the ease of use of a technology*.

H4b: *Personal innovativeness in the domain of information technology has a significant positive influence on individual beliefs about the ease of use of a technology*.

H4c: *Computer self-efficacy has a significant positive influence on individual beliefs about the usefulness of a technology*.

H4d: *Personal innovativeness in the domain of information technology has a significant positive influence on individual beliefs about the usefulness of a technology*.

3.4 Institutional factors

Institutional factors refer to one's perceived organizational support by organization and its management. Organizational support theory supposes that employees personify the organization, infer the extent to which the organization values their contributions and cares about their well-being, and reciprocate such perceived support with increased commitment, loyalty, and performance (Rhoades & Eisenberger, 2002).

High levels of perceived organizational support can be related to high levels of motivation employers have to help the organization reach its goals and objectives (Eisenberger et al, 1986).

Consistent with Eisenberger's proposition, research reveals that employees with high levels of perceived organizational support are more committed to the organizations they work for and more satisfied with their jobs (Rhoades & Eisenberger, 2002). Such employees are less likely to be tardy, absent, or resign (Allen, Shore, & Griffeth, 2003; Eisenberger et al., 1986), are more likely to go "above and beyond" formal job duties (Witt, 1991), and have higher in-role performance (Armeli, Fasolo, Eisenberger, & Lynch, 1998).

Organizational support theory also addresses the psychological processes underlying consequences of perceived organizational support. First, on the basis of the reciprocity norm, this support should produce a felt obligation to care about the organization's welfare and to help the organization reach its objectives. Second, the caring, approval, and respect connoted by it should fulfil socio-emotional needs, leading workers to incorporate organizational membership and role status into their social identity. Third, perceived organizational support should strengthen employees' beliefs that the organization recognizes and rewards increased performance (i.e., performance-reward expectancies).

Based on these assumptions, management commitment can be considered as the degree to which an individual perceives the management support for the use of the information

system. Behaviours of organizational actors are influenced by messages and signals relayed by top management and their immediate supervisors. Hence, I can say:

H5a: *Perceived management support for the use of a technology has a significant positive influence on individual beliefs about the usefulness of the technology.*

H5b: *Perceived management support for the use of a technology has a significant positive influence on individual beliefs about the ease of use of the technology.*

3.5 Social factors

According to Venkatesh et al. (2003), social influence is defined as the degree to which an individual perceives that important others believe he or she should use the new system.

In previous works it is represented with different labels. Although these different ways of defining it, each of these constructs contain the common notion that individual's behaviour is influenced "by the way in which they believe others will view them as a result of having used the technology" (Venkatesh et al., 2003).

In the present study, I consider all the root constructs took into account by Venkatesh et al. (2003), based on the work of Ajzen (1991), Davis et al. (1989), Fishbein and Azjen (1975), Mathieson (1991), Taylor and Todd (1995a, 1995b), Thompson et al. (1991).

Consistent with TRA, which was a key theoretical underpinning for the original development of TAM, I tap into social influences via subjective norms (Mathieson 1991; Taylor and Todd 1995b; Tompson et al. 1991), defined as the "perceived social pressure to perform or not perform the behaviour" (Ajzen 1991; p. 188). According to TAM and TPB subjective norm is a direct determinant of behavioural intention. This direct effect is due to the fact that people may choose to perform a behaviour even if they are not themselves favourable toward the behaviour or its consequences, if they believe one or

more important referents think they should, and they are sufficiently motivated to comply with referents (Venkatesh et al., 2000).

According to Kelman's (1958), this effect is manifest via the psychological pathways of internalization and identification. Via internalization, the individual incorporates the opinion of an important referent as part of his/her own belief structure: in essence, the referent's beliefs become one's own. Via identification, the individual seeks to believe and act in a manner similar to those possessing referent powers.

Therefore, compelling messages received from important others are likely to influence one's cognition about the expected outcomes of technology use.

In my conceptualization of social influence, I draw upon the work of Fulk (1993) and Schmitz and Fulk (1991). Fulk argued and empirically demonstrated that the extent to which salient others view technology use as valuable has a positive influence on one's own perceptions of usefulness. In other words, if a peer, supervisor, or some other actor in a relevant social network believes that a technology is useful, through a process of shared cognition, so will the target individual. However, Fulk's conceptualization did not include a measure of the importance of the referent other, also referred to in the TRA tradition as "motivation to comply." Doubtless, the potency of the influence will vary, depending on the significance an individual assigns to internalizing another's beliefs or identifying with them. Given the concerns expressed over the subjective norm operationalization used in TAM studies and subsequent equivocal findings in other work that employs it (e.g., Davis et al. 1989; Taylor and Todd 1995b). I thus adopt an expectancy formulation of social influence that is slightly different from the subjective norm operationalization used in the TAM tradition. Consistent with other work, however, I suggest that this form of social influence will amplify an individual's beliefs about the usefulness of an information technology. However, no such relationship is expected between social influence and ease of use beliefs.

Therefore, individuals often respond to social influences to establish or maintain a favourable image within a referent group (Kelman, 1958). As Pfeffer (1982) argues, by performing behaviours that are consistent with group norms "achieves membership and the social support that such membership affords as well as possible goal attainment which can occur only through group action or group membership". An individual may thus perceive that using a system will lead to improvements on his/her job performance indirectly due to image enhancement. This effect is capture in this model by the effect of social influence on perceived usefulness and perceived ease of use.

H6a: *Perceived social influence from referent others has a significant positive influence on individual beliefs about the usefulness of the technology*.

H6b: *Perceived social influence from referent others has a significant positive influence on individual beliefs about the ease of use of the technology*.

3.6 Relational factors

In the present work the analysis of relational variables is important to investigate whether or not a focal employee's beliefs about the employee-organization relationship are influenced by co-workers' perceptions about their relationships with the organization. Because co-workers are an important source of information about the job, the organization, policies, procedures, organizational events, and workplace norms (Morrison, 1993; Ostroff & Kozlowski, 1992; Rousseau, 1995; Rousseau, 2001), the information that employees acquire through their interactions with co-workers will shape their perceptions of technology usefulness and easy of use.

It is assumed, in fact, that individuals are embedded in social structures that influence their interpretation of organizational reality and regulate their access to or control over valued resources. As stated by Salancik and Pfeffer (1978), attitudes and perceptions are socially constructed; the social environment provides cues that make certain dimensions of the workplace more salient and more important or desirable than others.

Many researchers and theorists (Coleman, Katz & Menzel, 1966; Davis, 1989; Homans, 1950; Newcomb, 1943; Sprague, 1982) have agreed that people tend to adopt the views and actions of those with whom they associate. As Hackman contented, "the other people, with whom an individual interacts, can affect profoundly how that person thinks, feels and acts" (1976).

Two different substantive processes may account networks interaction effect: network centrality may influence individuals' perceptions by defining their status or position in the broader social context, or its effects may instead be largely attributable to social influence transmitted through specific interactions.

An explanation for the effect of centrality and network interactions on attitudes and perception is based on communication theory (Ibarra & Andrews, 1993). From this perspective, perceptions are socially constructed in the course of direct interactions with others, and network links are the channels through which organizational culture and norms are communicated (Rogers & Kincaid, 1981). The substantive processes are contagion and social comparison, which are predicted by direct interaction. Specific network contact provides opportunities for comparing and interpreting perceptions, which in turn influence information saliency and subsequent perceptions (Erickson, 1982; Rice & Aydin, 1991). In other words people develop shared attitudes and norms through exposure to proximate others in a social network (Wellman, 1983; Dean & Brass, 1985; Hartman & Johnson, 1989; Rice & Aydin, 1991). Favourable perceptions, therefore, are viewed as developed or reinforced in direct interaction with people who have favourable views: the greater an individual's centrality, the more likely he or she is to be in contact with others who perceived workplace features in favourable terms, hence in positive correlation between centrality and attitudes (Ibarra & Andrews, 1993).

With reference to network content in the present study has been considered advice, work and ease communication ties. As stated above, although friendship ties are based on affect, employees share information or advice related to the completion of their work, organizational policies, procedures and events through advice and work ties (Ibarra,

1993; Morrison, 1993; 2002). Based on this, advice and work ties should play a role in social information processing: when employees do not understand what is occurring in the organization, they will use advice and work ties to gain insight. Advice and others opinions-sharing exposes employees' to their co-workers' views and beliefs about the organization. This exposure or sharing will play a role in shaping beliefs about the treatment employees receive from the organization, leading to similarity in their attitudes towards technology.

Building on these assumptions I can say that network interaction affect individuals' perceptions through two mechanisms: localized social influence based on network proximity and systemic power based on network centrality. Specifically:

H7a*: The more central the individual in the advice network, the higher individual perceived usefulness of the system.*

H7b*: The more central the individual in the advice network, the higher individual perceived ease of use of the system.*

H7c: *The more central the individual in the work network, the higher individual perceived usefulness of the system.*

H7d: *The more central the individual in the work network, the higher individual perceived ease of use of the system.*

H7e: *The more central the individual in the ease of communication network, the higher individual perceived usefulness and perceived ease of use of the system.*

H7f: *The more central the individual in the ease of communication network, the higher perceived ease of use of the system.*

3.7 The research model

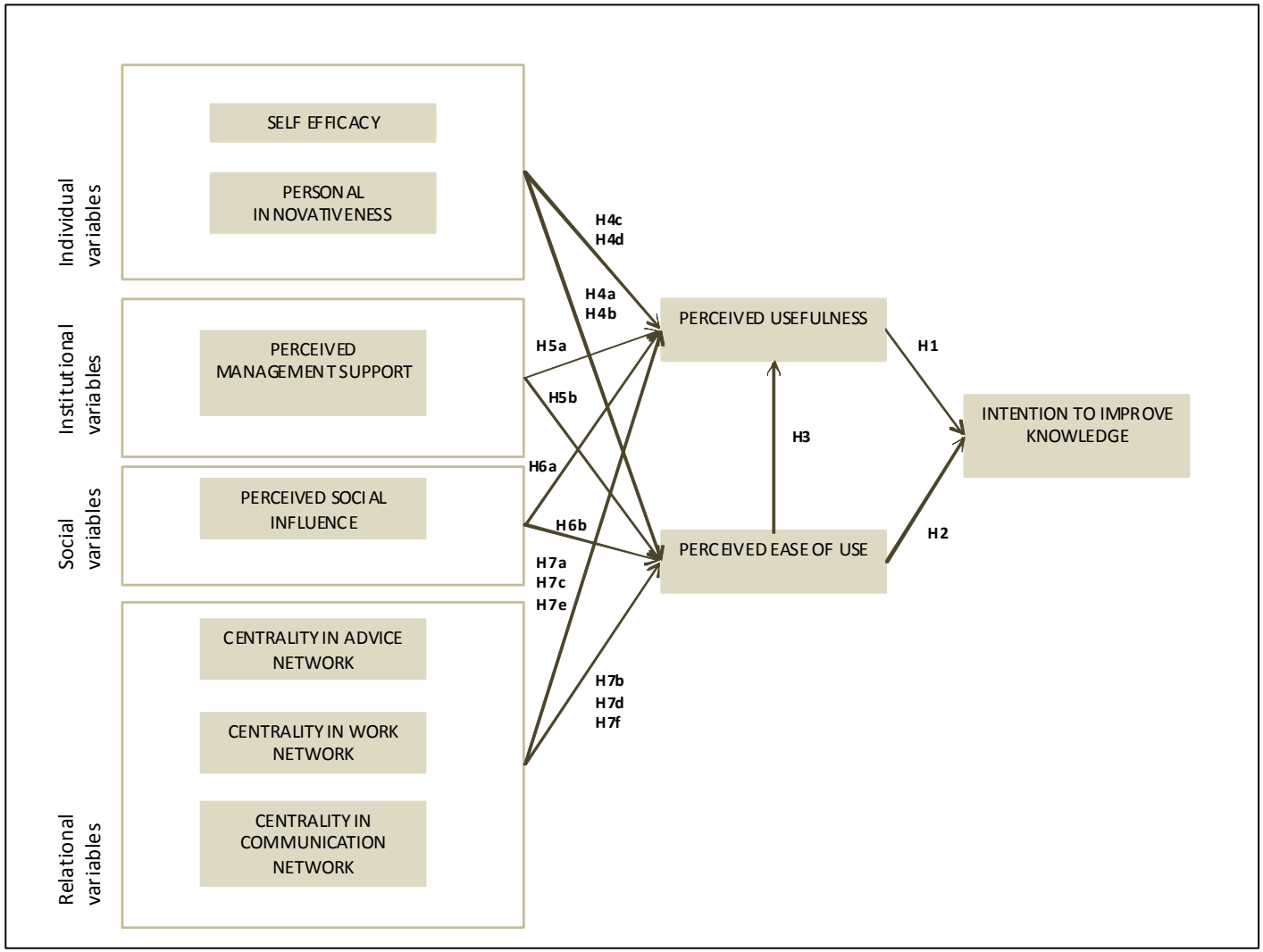
Figure n° 6 shows a synthesis of the developed model and the hypothesis that have to be tested.

The proposed research model, which adapted and incorporated aspects of many theories/models of technology acceptance and of social influence, shows the possible influence of four constructs (exogenous variables), individual factors, social factors, institutional factors, and relational factors, toward the perceived usefulness and the perceived ease of use of the system (endogenous variables), which, in turn, influence the depended variable, intention to improve the system knowledge (endogenous variable). Perceived ease of use also influences perceived usefulness.

Individual variables include both the constructs “personal innovativeness” and “self-efficacy”, while relational factors include measures of centrality of advice, work relations and ease of communication networks.

Exogenous variables (or independent variables), do not depend on other variables, and are considered as external.

Figure 6: The model



CHAPTER 4: RESEARCH DESIGN

4.1 Context

The present study is conducted into a well known Italian telecommunication company, which offers integrated fixed, mobile and Internet services.

The information system studied is an Enterprise Resource Planning tool, SAP R/3.

This choice is due to the fact that even though Enterprise Resource Planning (ERP) systems offer great promise to businesses, wanting to consolidate and integrate the many elements that comprise business practice (Palanisamy, 2008), there are well documented problems affecting their implementation.

4.1.1 Enterprise resource planning systems

ERP systems are a "packaged business software system that enables a company to manage the efficient and effective use of resources by providing a total, integrated solution for the organization's information-processing needs" (Fui-Hoon Nah, Lee-Shang Lau et al., 2001).

As Palanisamy stated, the challenge of ERP solutions lies in implementation because they are complex, time consuming and expensive to implement. Many companies have enjoyed the benefits of such systems, but, many have also had to settle for minimum returns, complete abandonment of the system, or even bankrupt (Mandal et al., 2002).

ERP software is highly configurable to accommodate the diverse needs of users across many sectors of the economy. Because of this, currently ERP software exists in three different forms: generic, preconfigured, and installed (Klaus et al., 2000):

1. In its most comprehensive form, the software is generic, targets a range of industries, and must be configured before it can be used.

2. Packaged, pre-configured templates have been derived from the comprehensive software. These templates are tailored towards specific industry sectors (e.g., automotive, retail) or companies of a certain size (SME).
3. For most users, ERP-software presents itself as the operational installation after the generic or pre-configured package has been individualized according to the particular firm's requirements on site.

The application modules of ERP are integrated across the supported functions and the involved data. ERP software is based on an underlying integrated database that stores master and transactional data in a consistent way and with controlled redundancy.

The main features of ERP-software are the provided business solutions, which support the core processes of the business and administrative functionality. ERP purports to support all business functions of an enterprise, especially procurement, material management, production, logistics, maintenance, sales, distribution, financial accounting, asset management, cash management, controlling, strategic planning, and quality management.

Although components of the main ERP solutions are at the highest level organized in different functional modules like financial accounting or sales, they all follow a process-oriented view of enterprises.

ERP targets multiple industries with very different characteristics. ERP supports multiple industries in two ways. ERP can have either the ability to support different industries within one solution (e.g., coexistence of manufacturing and retailing functionality) or offer preconfigured enterprise-individual solutions.

ERP is designed for companies that act (purchase, produce, sell, administer) in various countries. Thus, it is a prerequisite that ERP can handle the specific requirements of different regions. This includes preconfigured country-specific chart-of-accounts, preformatted document types like quotes, delivery notes or invoices, or HR-related rules (e.g., payroll).

Finally, frequency and repetition of its use could also be seen as an important and distinguishing feature. ERP supports recurring business processes like procurement, sales order processing or payment processes and is not focused on less structured, irregular processes like marketing, product development or project management.

In addition to integrated applications and data, a further technical characteristic of ERP software is the consistent graphical user interface (GUI) across all application areas. Thus, a user perceives the ERP solution as a single application regardless of the module he or she is working with. Existing ERP solutions are based on a three-tier client-server architecture, in which the database, the applications and the presentation, form three logically independent levels (Klaus et al. 2000).

The market leader of the ERP solutions is a German firm, SAP, whose software is the information system analysed in the present work.

4.2 Sample

The population of this research, the entire group of people that the researcher wishes to investigate is composed of all SAP users of a well known telecommunication company who are in its offices located in Rome.

Because of the peculiarities of the methodology implemented for data collection, the social network method, and the consequent necessity of collecting sensitive-personal data the definition of the sample was preceded by a request of authorization to personal data processing.

This preliminary step let us to identify a sample of 97 SAP users, which best embodies the main features of the population.

Among the employee that gave the authorization, 79 complete the survey, that is the 81,4% of the sample. One questionnaire has only one section completed, with seven questions answered, because the recipient doesn’t use SAP in his work anymore.

Of the sample 60% are female, 40 % are male. Most of them are between 30-40 years old (67%), the others are between 40-50 years old (27%), and only 6% are older. More than 50% has a master's degree, only 1% has a bachelor's degree, 42% has only an high school degree, while for the remainder of the sample there are missing data.

People are displaced on 6 different buildings and belong to 6 different departments.

4.3 Data Collection

This work is based on a survey research. To conduct the survey I received an important help from the Human Resource department, which gave a consistent contribution in the identification of the best way to create the questions, and distribute the questionnaire.

Indeed, the Human Resource department firstly provided a database with the attributional variables, such as gender, age, kind of academic education, and function and then helped me to develop the questionnaire with the aim at tailoring the questions according to the firm's peculiarity and environment. Then it was adapted, by the information technology division, to a graphic interface on the company web site and sent by the Human Resource department to all the employees of the sample via e-mail. The data collection covered a period of three weeks with a remainder mail sent in the second week.

4.4 Data analysis

Data analysis was splitted into two stages: the first stage involves the creation of network diagrams, the calculation of network indexes and the inter-network comparisons by using UCINET (Borgatti, Everett, and Freeman, 2002).

The second stage involves descriptive statistics, factor analysis and correlation through the method of principal-component factors, and the regression analysis, by using STATA/SE 10.0.

Statistical techniques used in this research were categorised into two groups: techniques used to analyze network data and Structural Equation Modelling (three stage least square).

4.4.1 Social network analysis

A social network consists of a finite set or sets of actors and the relation or relations defined on them (Wasserman and Faust, 1994).

Actors are social entities who are discrete individual, corporate or collective social units. Actors are linked to one another by social *ties*. The collection of ties of a specific kind among members of a group is called a *relation.*

Social network analysts use *graphs* and its theories to formally represent social relations and quantify important social structural properties. A graph $\mathcal{G}$ consists of two sets of information: a set of nodes $\mathcal{N} = \{n_1, n_2, ..., n_g\}$, and a set of lines, $\mathcal{L} = \{l_1, l_2, ..., l_L\}$ between pairs of nodes.

In this study the relationships are directional so the graphs must be *directed graphs*. A relation is directional if the ties are oriented from one actor to another. In the present study, for example, choices of advice are directional relation. One person could ask for advice to another, but this doesn't imply that this relation is reciprocated.

A *directed graph* consists of two sets of information: a set of nodes $\mathcal{N} = \{n_1, n_2, ..., n_g\}$ and a set of arcs $\mathcal{L} = \{l_1, l_2, ..., l_L\}$. Each arc is an ordered pair of distinct nodes, $l_k = < n_i , n_2 >$. The arc $< n_i , n_j >$ is directed from n_i (the origin of the sender) to n_j (the terminus or receiver). The difference between an arc (in the diagraph) and a line (in the graph) is that an arc is an ordered pair of nodes (to reflect the direction of the tie between the two nodes) whereas a line is an unordered pair of nodes (it simply records the presence of a tie between two nodes).

In this analysis the nodes are the recipients of the questionnaire (N= 97), who are tied through three different relationships all SAP-based: advice, work relations and communication.

To create the networks the questionnaire has been structures to obtain three kind of information:

- The *advice* ties. This network was generated on the data collected by asking to the sample: "To whom do you ask for advices about how to use SAP to accomplish your work?".
- The *workflow* ties. This network was generated by asking them: "With whom do you relate to perform your tasks which are SAP use-based?".
- The network that shows ties of *ease of communication* is derived by asking: "With whom is it easer for you to relate to discuss problems or task which are SAP-based?."

In each section, the questionnaire asked recipients to look carefully down an alphabetical list of other colleagues and place checks next to the names of people while answering the questions. Data for each relation was arranged in 97 x 97 matrices[8]. In each matrix cell X_{ij} corresponded to *i*'s relation to *j* as reported by *i*. For example, if *i* reported *j* as a person to whom he/she asks for advice, then the cell X_{ij} in the advice matrix was coded as 1, otherwise X_{ij} was coded as 0.

The Appendix 1 reports descriptive statistics that provide a general sense of the networks generated by the three types of relations among people.

The *density* of a directed graph is equal to the proportion of arc present in the diagraph. It is calculated as the number of arcs, L, divided by the possible number of arcs. If density is equal to 1, then all dyads are mutual.

[8] The information in a graph may also be represented in a variety of ways in matrix form. In the present work has been used the adjacency matrix, whose entries in the matrix indicate whether two nodes are adjacent or not.

$$\Delta = \frac{L}{g(g-1)}$$

In the analysis it is low in each of the three networks but it is higher in advice and work-based network.

In a graph, the degree of a node is the number of nodes adjacent to it. In a diagraph, a node can be either adjacent to, or adjacent from another node, depending on the direction of the arcs.

Nodal *in-degree* represents the number of nodes that are adjacent to n_i. The in-degree is thus the number of arcs terminating at n_i. The *out-degree* of a node is the number of nodes adjacent from n_i. Out-degree is thus the number of arcs originating with node n_i.

As shown in the appendix, mean in-degree and mean out-degree, in the three networks, are equal since they consider the same set of arcs but from different directions. Unlike the mean in-degree and the mean out-degree, the variance of in-degree is not necessarily the same as the variance of the out-degrees.

Appendix 3 provides the visualization of each network. Figures show the relations between students (communication, friendship, advice and esteem) and the nodes attributes.

As stated above the software, used to conduct social network analysis, is UCINET (Borgatti, Everett and Freeman (2002), and its integrated NetDraw program for drawing diagrams of social networks.

With reference to gender, this attributional variable doesn't show any particular influence on all the three networks. Male and female seem to be combined together in the networks without any reason linked with gender attribute.

The same happens with the attribute education. People ask for advice to others both with the same or different level of education. This attribute doesn't explain individual choices for advice, and effortlessness in the communication, as well as in the job relations SAP-based.

Different results come out in concern with similarities in the organizational function and in the physical position. Nodes show a tendency to ask for advice to, to have to relate to and to prefer to communicate easily with people who belong to the same department and to the same building. In addition in the three networks, nodes with an high in-degree, that is people who are nominated most, all belong to the same function (a SAP expert function) while the others mainly belong to other departments.

To better understand the relationships and the interactions of network variables as well as attributional variables, it is conducted a correlation and regression analysis.

4.4.1.1 Quadratic Assignment Procedure

UCINET can calculate inter-network comparisons, such as Quadratic Assignment Procedure (QAP).

As network data observations were not independent and did not satisfy assumptions of statistical inference in traditional regression, special procedures were adopted to run correlations and multiple regressions: the Quadratic Assignment Procedure (QAP) and multiple regression quadratic assignment procedure (MRQAP) (Baker and Hubert, 1981; Krackhardt, 1987, 1988; Borgatti and Everett, 1999).

Quadratic Assignment Procedure (QAP) correlation is a measure to compare the similarity of two networks (Krackhardt, 1988). Standard correlation techniques should not be used to compare matrices representing networks because the data in rows and columns are typically related. The QAP procedure seeks to avoid this by bootstrapping approach: comparing the similarity of the matrix pair with their similarity after random

permutations of the rows and columns of one of them. The QAP correlation reports the proportion of these permutations that produce less similar pairs of networks (Thelwall et al., 2004).

MRQAP is a network regression technique that allows the analysis of relational data of social networking that is systematically interdependent. What make network data particularly troublesome is the autocorrelation that compromises the estimated standard errors (Krackhardt, 1988). The main advantage of MRQAP is that it is robust against varying amounts of row and column autocorrelation in the dyadic data thus reducing the bias resulting from the interdependence of observations if Ordinary Least Square techniques (OLS) are used (Doreian & Chi-Hsien, 1984). MRQAP is a nonparametric statistical algorithm that regresses a dependent matrix against one or several independent matrices. Using this technique the researcher first performs a standard multiple regression analysis across corresponding cells, in which each cell reflects a dyad of dependent and independent matrices. Then a random permutation of the rows and columns of the dependent matrix is performed for recalculating the regression model. This permutation regression process is repeated many times for estimating the standard error for the statistic of interest while keeping the resultant values of r-square and all coefficients for each rearrangement in store (Kilduff & Krackhardt, 1994).

4.4.2 Structural equation modelling

Structural equation models (SEM), is a multivariate technique combining aspects of multiple regression (examining dependence relationships) and factor analysis (representing unmeasured concepts-factors with multiple variables) to estimate a series of interrelated dependence relationships simultaneously (Hair et al. 2006; Schumacker & Lomax 1996). SEM also integrates other techniques such as recursive path analysis, non-recursive econometric modelling, ANOVA, analysis of covariance, principal component analysis and classical test theory (Holmes-Smith, 2000). In addition, SEM is

also known as path analysis with latent variables and is now a regularly used method for representing dependency (arguably "causal") relations in multivariate data in behavioural and social sciences (McDonald & Ringo Ho 2002).

Unlike the more traditional multivariate linear model, however, the dependent variable in one regression equation in an SEM may appear as a predictor in another equation; indeed, variables in an SEM may influence one-another reciprocally, either directly or through other variables as intermediaries. These structural equations are meant to represent causal relationships among the variables in the model.

Structural equations can be defined under three-stage least square. In three stage least square all dependent variables are explicitly taken to be endogenous to the system. Typically, the endogenous explanatory variables are dependent variables from other equations in the system. The disturbance is correlated with the endogenous variables, thus violating the assumptions of ordinary least squares. Further, since some of the explanatory variables are the dependent variables of other equations in the system, the error terms among the equations are expected to be correlated.

Three-stage least squares can be thought of as producing estimates from a three-step process.

Stage 1. Develop instrumented values for all endogenous variables. These instrumented values can simply be considered as the predicted values resulting from a regression of each endogenous variable on all exogenous variables in the system.

Stage 2. Obtain a consistent estimate for the covariance matrix of the equation disturbances. These estimates are based on the residuals from a two-stage least-squares estimation of each structural equation.

Stage 3. Perform a GLS-type estimation using the covariance matrix estimated in the second stage and with the instrumented values in place of the endogenous variables.

The STATA command used in this study is reg3.

4.5 Variables

The questionnaire contained multiple measurement items related to each of the constructs in the research model. Consistent with research literature in the area, multi-items self-report Likert type scales (ranging from 1 - strongly disagree - to 7 - strongly agree) were used to measure all variables.

The questionnaire (see appendix) is composed by 15 questions divided as follow:

- 10 questions measure the independent variables, i.e. self-efficacy, personal innovativeness, perceived ease of use, perceived usefulness, social influence, and institutional support;
- 3 questions measure the relational independent variables, i.e. intra-organizational relations connected to SAP use;
- 1 question measures a control variable, i.e. the SAP use by the questionnaire recipients;
- 1 question measure the dependent variable.

As stated above, in the traditional perspective the *dependent variable* is assumed to be the user behaviour, i.e. the actual use of the system which depends from the behavioural intention of the system's user. In the present work, I introduce a new variable considered a good proxy of individual acceptance of technology, a variable that describe one's intention to improve knowledge about SAP.

Perceived usefulness is a scale consisting of three items from Davis (1989) measuring the extent to which a person believed that SAP was capable of being used advantageously and provided positive expected outcomes.

Perceived ease of use measures the degree to which a person believed that using a particular technology system would be free of cognitive effort. The scale consisted of three items, developed and validated by Davis (1989).

Self efficacy is a scale, consisting of five items from Agarwal and Karahanna (2000), measures one's confidence in his/her ability to perform a particular task (Bandura 1997).

Personal innovativeness, measuring the willingness of an individual to try out any new information technology, is based on two items proposed by Agarwal and Prasad (1998).

Management support, defined as the degree to which organisational influences facilitate the PU/PEOU of an information system, is measured through one item adapted from Venkatesh (2003), Yoon et al. (1995) and Magni (2004).

Subjective norms measure the degree to which an individual perceives that important others believe he or she should use the system and is based on two items from Fishbein e Ajzen (1975).

4.5.1 Network variables

Because in social network analysis the presence of relations among actors has implications for a number of measurement issues, it is important to define in an unambiguous way the *unit of analysis*. For the aim of the present work, that is to analyse the acceptance of a defined technology by a single individual, it is necessary to focus on the actors at the monadic level, that is consider properties pertaining to actors.

The object of the analysis is the so called *ego-centred network* (Burt, 1984), that consists of a focal person (ego), a set of alters who have ties to ego, and measurement on the ties from ego to alters and on the ties between alters.

Indices which attempt to quantify the prominence of an individual actor embedded in a network are the measures of centrality. *Centrality* of a network indicates who has the most influential connections to and from other actors.

Actor centrality is introduced into the model as a measure considering the prominence of the actor in the network. Prominent actors are those that are extensively involved in relationships with other actors. This involvement makes them more visible to the others.

In other words prominent actors are those who are most active in the sense that they have the most ties to other actors in the network.

The simplest definition of actor centrality is the *degree centrality*. As stated in the paragraph 4.5.1, degree centrality was determined by individuals' frequencies of (incoming/outgoing) communications with others. It is assumed that when an actor has a high degree centrality, the actor is playing an important role (such as an opinion leader) in the social network (Freeman, 1979).

Following suggestions made by previous authors (Proctor and Loomis, 1951; Shaw, 1964) and then reviewed by Freeman (1979), Wasserman and Faust (1994) define as an actor-level degree centrality index as:

$$C_D(n_i) = d(n_i) = x_{i+} = \sum_j x_{ii} = \sum_i x_{ii}$$

With directed data, however, it can be important to distinguish centrality based on in-degree from centrality based on out-degree. If an actor receives many ties, they are often said to be prominent, or to have high prestige. That is, many other actors seek to direct ties to them, and this may indicate their importance. Actors who have a high out-degree are actors who are able to exchange with many others, or make many others aware of their views. Actors who display high out-degree centrality are often said to be influential actors. In social network applications, these degrees can be of great interest.

Specifically the actor-level out-degree centrality index for directional relations is:

$$C'_D(n_i) = x_{i+} / (g-1)$$

Another measure of centrality is *closeness*. This index measures how close an actor is to all the others actor in the set of actors. The idea is that an actor is central if he can quickly interact with all others: central nodes in a network have the shortest paths when

relating to all others. Closeness centrality approach emphasizes the distance of an actor to all others in the network by focusing on the geodesic distance from each actor to all others. With a direct graph, the geodesic from n_i to n_j may not be the same as the one from n_j to n_i, so that $d(n_i, n_j)$, the length of the geodesic, may not equal $d(n_j, n_i)$.
Specifically the actor-level closeness centrality index for directional relations is:

$$C'_D(n_i) = (g-1) / \left[\sum_{j=1}^{g} d(n_i, n_j)\right]$$

Both degree and closeness centrality measures indicate opportunities for access to and forwarding of information. By facilitating, controlling, or inhibiting the flow of information from one site to another in the network, central actors can maintain, create, or prevent the creation of information pathways. This central position is an ideal place for an information facilitator such as information professional who can stimulate the growth of successful information pathways. However, the information professional may need to identify how to become central in an environment, and the first stage in such an endeavour is to define the existing network structure. Alternately, the information professional may identify who is central to the network and then use that knowledge to identify the starting point for the dissemination of information (Haythornthwaite, 1996).

The third measure of centrality use in the present work is *betweenness.*

Betweenness centrality views an actor as being in a favoured position to the extent that the actor falls on the geodesic paths between other pairs of actors in the network. That is, the more people depend on one actor to make connections with other people, the more power this actor has.

"The betweenness of a point measures the extent to which an agent can play the part of a broker or gatekeeper with a potential for control over others" (Scott, 1991, pp. 89-90). Although this actor may be connected directly to very few others (have a low degree as

defined earlier), betweenness can indicate the extent to which he or she plays the role of an intermediary.

The actor betweenness index for n_i is defined as:

$$B(n_i)=\sum_{j<k} g_{jk}(n_i)/g_{jk}$$

In the present study I used all the three measures of centrality, weighting them for the *actual use* of SAP.

Actual use was measured through two items. The first is like a control item to check respondents' use of the system. In the second item the system use is measured as 1 if respondents use SAP annually, 2 if they use SAP monthly, 3 if they used SAP weekly, 4 if daily.

Each centrality index was multiplied for the individual actual use of the system to give different weight to potential relational influences, assuming that those influences depend on the real use and consequently the real experience with the system. The basic assumption in fact is than no-one can influence others perceptions of SAP, without even have a basic experience with it.

Table n°1 summarizes all the scales and items used in this model, which was revised on the basis of previous research.

Table 1: Scales and items

VARIABLES	CODES	DEFINITIONS	SOURCE OF CONSTRUCT
Perceived usefulness	PU	The degree to which a user believes that using SAP will enhance performance.	Davis (1989) Venkatesh et al. (2003)
Perceived ease of use	PEOU	The degree to which a user believes that using SAP will be free of cognitive effort.	Venkatesh et al. (2003)
INDIVIDUAL VARIABLES			
Self efficacy	SE	One's confidence in his/her ability to perform a particular task.	Bandura (1977)
Personal innovativeness	PI	The willingness of an individual to try out any new information technology.	Rogers (1955) Agarwal e Prasad (1988)
SOCIAL VARIABLES			
Subjective norms	SV	The degree to which an individual perceives that important others believe he or she should use SAP.	Fishbein e Ajzen (1975)
INSTITUTIONAL VARIABLES			
Management support	IV	The degree to which organisational influences facilitate the PU/PEOU of SAP.	Yoon et al.(1995) Magni (2004)
RELATIONAL VARIABLES			
Prestige	FDAO, FDWO, FDEO	The number of link whose head is connected to a particular actor.	Freeman (1977, 1979)
Closeness	CECI, CECO, CAI, CAO, CWRI, CERO	How close an actor is to other actors in the network.	Freeman (1977, 1979)
Betweenness	BA, BEC, BWR	The extent to which a network member lies between others not directly connected.	Freeman (1977, 1979)

CHAPTER 5: RESULTS

5.1 Descriptive statistics

Table n° 2 shows the descriptive statistics of the variables, which display the minimum observation, and the maximum observation for each variable, the mean, and the standard deviation.

Table 2: Descriptive statistics

VARIABLE	OBS	MEAN	STD.DEV	MIN	MAX
AU	78	3,615385	0,8095336	1	4
I	78	5,602564	1,351668	2	7
PU	78	5,812179	1,058055	1,33	7
PEOU	78	5,333333	1,293507	2	7
SE	78	5,617949	0,6700928	3,8	7
PI	78	3,794872	1,282844	1	7
SV	78	5,064103	1,196203	1,5	7
IV	78	4,730769	1,491735	1	7
FDAO	78	1,230769	1,257942	0	5
FDAI	78	1,115385	1,865481	0	10
FDEO	78	0,9871795	1,050585	0	4
FDEI	78	0,8974359	1,583927	0	7
FDWO	78	0,9230769	1,113894	0	5
FDWI	78	0,8205128	1,336244	0	6
CECI	78	9,084539	0,5445918	6,942	9,312

CECO	78	9,073487	0,2697153	8,285	9,312
CAI	78	9,065667	0,538698	6,282	9,312
CAO	78	9,052154	0,3076398	9	9,312
CWRI	78	9,123423	0,3743274	7,714	9,312
CWRO	78	9,0919	0,313776	8,181	9,312
BWR	78	2,679487	8,676724	0	50
BA	78	2,326923	6,339849	0	37
BEC	78	2,730769	8,253568	0	42

pu = perceived usefulness; **peou** = perceived ease of use; **se** = self efficacy; **pi** = personal innovativeness; **sv** = social variables; **iv** = institutional variables; **fdao** = out-degree advice; **fdai** = in-degree advice; **fdeo** = out-degree ease of communication; **fdei** = in-degree ease of communication; **fdwo** = out-degree work relations; **fdwi** = in-degree work relations; **ceci** = inFarness ease of communication; **ceco** = outFarness ease of communication; **cai** = inFarness advice; **cao** = outFarness advice; **cwri** = inFarness work relations; **cwro** = outFarness work relations; **bwr** = betweenness work relations; **ba** = betweenness advice; **bec** = betweenness ease of communication.

As shown in table respondents use SAP on average more than once a week. The mean shows a value of 3,6, strictly close to the observations maximum value which explains a daily use[9].

An important result is that the intention to improve SAP knowledge is very strong, the mean is 5,6 in a scale from 1 to 7. Moreover, no one strongly disagree with the same question probably because SAP is considered a useful tool for ones productivity (the minimum value is 2). This response shows that users perceive SAP not so difficult to use, while this value is lower than that referred to the perceived usefulness (mean = 5,8). The scales explaining individual variable show that a high percentage of respondents are very confident in their ability to perform a particular task (mean=5.6 and standard deviation=0,67) even if their rate of innovativeness is lower (mean=3,7). Moreover, the

[9] As stated in the previous chapter, the scale used for the item "actual use" is from 1=annually to 4=daily.

perception of external pressures to use the system is quite high, while the management support is perceived as moderate, but never absent.

Considering network variables, table shows separately the indexes of centrality. For Freeman degree has been calculated in-degree and out degree. Each network (advice, work and ease of communication) shows different values for in-degree and out-degree. On average the nodes show an higher propensity to nominate many others as trustworthy, as work referent, and people with whom is ease to communicate, than to receive many nominations or choices from others for the same reasons. Different results are shown by closeness measurement, in which inFarness[10] and out farness are on average almost the same. This means that the distance anyone has to others and from others is almost the same. Finally, betweenness, even if on average is similar in each of the three networks, shows a higher maximum in workflow network while the lower is in advice one. This means that agents play the role of gatekeeper or broker with a potential control on the others, not based on trust relations or on sharing mental models of communication but based on roles formally determined.

For the aim of the present study in the model I decided to include only in-degree centrality, although I test also the others, because it focuses solely on the actor as a recipient and then it let us understand possible influences ego can receive from alters in the network. On the contrary, on one hand closeness centrality shows only the nearness of one actor to others and the possibility to have access to certain information, on the other, betweenness centrality gives us a measure of who are intermediary nodes, data that are not so relevant for the aim of the present study.

[10] The farness is the sum of the geodesic distances for each actor to others, and a geodesic distance is the number of steps in the shortest path from one node to another node.

5.2 Correlation analysis

A correlation analysis was performed to examine linkages between independent variables in the research model as well as their direction (positive and negative relationships) and strength of interrelations. The sign (+ or -) indicates the direction of the relationship. The value may range from -1 to +1, with values close to zero indicating little or no association between the variables concerned, and +1 indicating a perfect positive relationship in contrast to -1 showing a perfect negative or reverse relationship (Hair et al. 1995). According to Bühl and Zöfel (1995), the correlation coefficient r is interpreted as follows:

Table 3: Categorization of power of statistical correlations

CORRELATION COEFFICIENT	INTERPRETATION OF CORRELATION
< 0,20	Very low
0,21 – 0,50	Low
0,51 – 0,70	Medium
0,71 – 0,90	High
> 0,90	Very high

Source: Bühl and Zöfel (1995)

In table below is presented the correlation analysis of the independent variables.

The cells with a grey background in this table show that correlations exist between some items belonging to different constructs.

Centrality indexes do correlate significantly with each other, while other variables don't show any kind of linkages.

These results suggest that it is possible to compress and reduce the multiple items. This procedure, the so-called factor analysis, is the next step in the examination of the research model.

Table 4: Correlation analysis

	PU	PEOU	SE	PI	SV	IV	FDAO	FDAI	FDEO	FDEI	FDWO	FDWI
PU	-											
PEOU	0,28	-										
SE	0,04	0,15	-									
PI	0,23	0,20	0,13	-								
SV	0,31	0,15	-0,15	0,04	-							
IV	0,37	0,03	-0,15	-0,04	0,04	-						
FDAO	0,05	0,03	0,30	-0,01	0,13	0,00	-					
FDAI	0,12	0,38	0,10	0,03	0,19	0,11	0,02	-				
FDEO	0,05	0,07	0,18	0,04	0,08	-0,07	0,58	0,17	-			
FDEI	0,05	0,35	0,04	0,05	0,19	0,19	0,00	0,83	0,19	-		
FDWO	0,11	0,08	0,26	-0,11	0,07	-0,08	0,51	0,05	0,59	0,13	-	
FDWI	0,03	0,35	0,00	0,08	0,18	0,07	0,00	0,73	0,23	0,84	0,12	-

pu = perceived usefulness; **peou** = perceived ease of use; **se** = self efficacy; **pi** = personal innovativeness; **sv** = social variables; **iv** = institutional variables; **fdao** = out-degree advice; **fdai** = in-degree advice; **fdeo** = out-degree ease of communication; **fdei** = in-degree ease of communication; **fdwo** = out-degree work relations; **fdwi** = in-degree work relations.

5.3 Factor analysis

Factor analysis addresses the problem of analyzing the structure of the correlations among a large number of variables (i.e. test items) by defining a set of common underlying dimensions known as factors.

Principal component analysis (PCA) is a technique for identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. Since patterns in data can be hard to find in data of high dimension, where the luxury of graphical representation is not available, PCA is a powerful tool for analysing data. The other main advantage of PCA is that once you have found these patterns in the data, and you compress the data (i.e. by reducing the number of dimensions), without much loss of information. This result is not achieved reducing the variables number but reducing information redundancy caused by the observation of correlated variables. New factors let us combine variables, simplifying following statistics and analyze multicollinearity.

For the analysis it has been used the software STATA.

In order to decide on the number of factors to extract, it is applied both the *eigenvalue* and the *scree test criterion*. The first and most commonly used technique determines the variables contributing a value of 1 to the total eigenvalue. Thus, only the factors having eigenvalues greater than 1 are considered significant. The scree test is used to identify the optimum number of factors that can be extracted before the amount of unique variance begins to dominate the common variance structure (Hair et al. 1995).

Table 5: Factor analysis

Factor	*Eigenvalue*	*Difference*	*Proportion*	*Cumulative*
Factor 1	2,91120	0,73918	0,2911	0,2911
Factor 2	2,17202	0,63826	0,2172	0,5083
Factor 3	1,53376	0,47760	0,1534	0,6617
Factor 4	1,05617	0,25963	0,1056	0,7673
Factor 5	0,79653	0,32723	0,0797	0,8470
Factor 6	0,46931	0,07035	0,0469	0,8939
Factor 7	0,39895	0,08455	0,0399	0,9338
Factor 8	0,31441	0,07612	0,0314	0,9652
Factor 9	0,23829	0,12891	0,0238	0,9891
Factor 10	0,10937	-	0,0109	1,0000

As shown in table n° 5 four factors have an eigenvalue greater than 1, explaining together more than 76% of the total variance, a positive result that well resumes the relationships among the observed variables.

The scree-plot displayed in figure n° 7 shows a gradual decrease in eigenvalues. However, the contributions are relatively low after the fourth component, which agrees with the previous conclusion that four principal components provide a reasonable summary of the data.

Figure 7: Scree plot

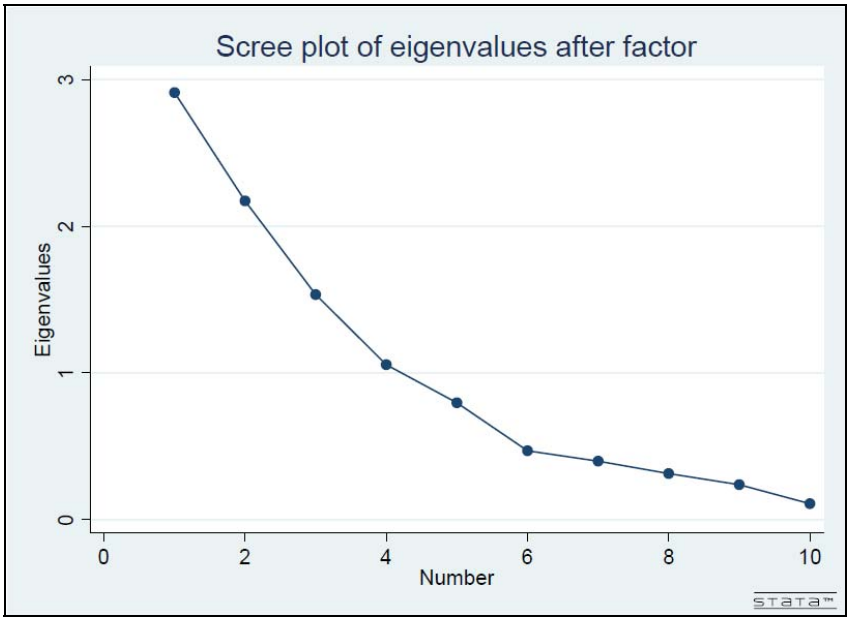


Table n° 6 shows the eigenvectors of the correlation matrix. It contains the first four eigenvectors of the correlation matrix. Eigenvectors correspond to each of the eigenvalues and associated principal components, and are used to form linear combinations of the Y variables. Each column of the table corresponds to the four principal components.

Table 6: Eigenvectors

Variable	*Factor 1*	*Factor 2*	*Factor 3*	*Factor 4*	Uniqueness
SV	0,3758	-0,0641	0,7885	0,1565	**0,2085**
IV	0,2121	-0,2399	0,8402	0,0470	**0,1893**
PI	0,1498	-0,0282	-0,1340	0,8929	**0,1615**
SE	0,2441	0,4628	-0,2192	0,3854	**0,5297**
FDAO_AU	0,3485	0,7539	0,1803	0,0541	**0,2747**
FDAI_AU	0,8246	-0,3538	-0,1843	-0,0607	**0,1571**
FDEO_AU	0,5454	0,6384	-0,0230	-0,1228	**0,2793**
FDEI_AU	0,8510	-0,4053	-0,1594	-0,0551	**0,0832**
FDWO_AU	0,3946	0,7105	0,0314	-0,2312	**0,2851**
FDWI_AU	0,8149	-0,3539	-0,2160	-0,0740	**0,1585**

se = self efficacy; **pi** = personal innovativeness; **sv** = social variables; **iv** = institutional variables; **fdao_au** = out-degree advice*actual use; **fdai_au** = in-degree advice*actual use; **fdeo_au** = out-degree ease of communication*actual use; **fdei_au** = in-degree ease of communication*actual use; **fdwo_au** = out-degree work relations*actual use; **fdwi_au** = in-degree work relations* actual use.

Table n° 7 shows the pattern matrix that offers a clearer picture of the relevance of each variable in the factor. Examining the coefficient making up the eigenvector, we can say that Factor 1 is strongly correlated with Freeman in-degree centrality measures of the three networks while Factor 1 with Freeman out-degree centrality measures of the three networks. Moreover, Factor 2 shows a high correlation with social variables and institutional variables and, finally, Factor 4 is strongly correlated with the variables "personal innovation" and "self efficacy". Factor 1 one can be considered as a representative factor of the degree of prestige of each individual, Factor 2 as representative of the degree a person can influence others. Factor 3 represents the perception of external pressures to the system use, supported by the management commitment. Finally, Factor 4 shows individual confidence on using the system (i.e. self-efficacy and the attitude to be innovative).

Table 7: Pattern matrix

Variable	*Factor 1*	*Factor 2*	*Factor 3*	*Factor 4*	**Uniqueness**
SV	0,1242	0,1396	0,8665	0,0763	0,2085
IV	0,0588	-0,0760	0,8927	-0,0684	0,1893
PI	0,0771	-0,0553	0,0240	0,9104	0,1615
SE	0,0233	0,4687	-0,1782	0,4673	0,5297
FDAO_AU	-0,0823	0,8286	0,1374	0,1142	0,2747
FDAI_AU	0,9135	0,0560	0,0619	0,0386	0,1571
FDEO_AU	0,2092	0,8225	-0,0150	-0,0144	0,2793
FDEI_AU	0,9511	0,0231	0,1006	0,0402	0,0832
FDWO_AU	0,0466	0,8320	-0,0229	-0,1412	0,2851
FDWI_AU	0,9150	0,0511	0,0278	0,0291	0,1585

se = self efficacy; **pi** = personal innovativeness; **sv** = social variables; **iv** = institutional variables; **fdao_au** = out-degree advice*actual use; **fdai_au** = in-degree advice*actual use; **fdeo_au** = out-degree ease of communication*actual use; **fdei_au** = in-degree ease of communication*actual use; **fdwo_au** = out-degree work relations*actual use; **fdwi_au** = in-degree work relations* actual use.

Table n° 8 shows the correlations between the four factors.

Table 8: Correlation matrix for new factors

	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**
Factor 1	0,8548	0,4519	0,2285	0,1135
Factor 2	-0,4334	0,8846	-0,1600	0,0637
Factor 3	-0,2634	0,0537	0,9520	-0,1467
Factor 4	-0,1102	-0,1018	0,1264	0,9806

5.4 Regression Analysis

Once reduced the number of factors and removed any kind of correlation among independent variables, a three stage regression analysis was performed with the purpose of examining the research model and its proposed hypotheses.

As stated above, the STATA command used to make the analysis is reg3, which estimates a system of structural equations, where some equations contain endogenous variables among the explanatory variables.

Table below reports the diagnostics for the "intention to improve knowledge about SAP", "Perceived usefulness" and "Perceive ease of use" of the system. These three variables are considered the *endogenous variables* of the model, while the independent variable is only the intention to improve knowledge. The others are exogenous variables, that is they aren't explained by the model.

The intention to improve the knowledge about SAP estimated function is very good, as well as those of the other two endogenous variables, as shown by the p-values of table 9, that is not ever lower than 0,01%.

Table 9: Regression

```
------------------------------------------------------------------------------
Equation           Obs  Parms        RMSE    "R-sq"       chi2        P
------------------------------------------------------------------------------
i                   78      2    1.624066   -0.4624      11.26   0.0036
pu                  78      5    .9351919    0.2086      25.99   0.0001
peou                78      4    1.164802    0.1786      17.30   0.0017
------------------------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
i            |
          pu |   1.615249   .5951325     2.71   0.007     .4488111    2.781688
     peou_au |  -.0351353   .0453913    -0.77   0.439    -.1241006    .0538299
       _cons |  -3.103794   2.855765    -1.09   0.277    -8.700991    2.493402
-------------+----------------------------------------------------------------
pu           |
        peou |   .3042599   .1112116     2.74   0.006     .0862892    .5222306
          f1 |  -.0455177   .0834045    -0.55   0.585    -.2089874     .117952
          f2 |   .1172489   .0750268     1.56   0.118    -.0298009    .2642987
          f3 |   .3768839   .1016618     3.71   0.000     .1776305    .5761374
          f4 |   .0841963   .0829907     1.01   0.310    -.0784625    .2468552
       _cons |    4.18946   .6023405     6.96   0.000     3.008895    5.370026
-------------+----------------------------------------------------------------
peou         |
          f1 |   .4727784   .1316479     3.59   0.000     .2147532    .7308036
          f2 |   .0755801   .1314407     0.58   0.565    -.1820389    .3331991
          f3 |   .0704177   .1325165     0.53   0.595    -.1893099    .3301453
          f4 |   .2571015   .1316067     1.95   0.049    -.0008428    .5150458
       _cons |   5.333333   .1318765    40.44   0.000      5.07486    5.591807
------------------------------------------------------------------------------
Endogenous variables:  i pu peou
Exogenous variables:   peou_au f1 f2 f3 f4
------------------------------------------------------------------------------
  ***<0,001 **<0,01 *<0,05
```

Picture n° 8 shows a synthesis of the model variables, with their coefficients and the explained variance. For a better and clearer description only the significance relations are shown.

In the model it was assumed that the "intention to improve knowledge of SAP" is determined by "perceived usefulness" and "perceived ease of use". Only the first of these hypothesis is verified (coeff=1,62, p<0,1), while this impact is not true for the "perceived ease of use".

This result, contrasting with previous studies, could be due to the dependent variable that, as stated above, is different from the dependent variables chosen by other authors. The intention to use SAP and the intention to improve knowledge of it could be considered as good proxies of individual behaviour but can give different outputs. In this case, the dependent variable is affected only by the perception of usefulness, thus proving that the system is conceived as worthy of being studied in depth in all its functionality only if its usefulness is perceived, while it is irrelevant its user-friendliness perception.

As expected, perceived ease of use influences perceived usefulness together with Factor 4, that represents the perception of external pressures to the system use, supported by the management commitment. The influence of perceived ease of use on perceived usefulness confirms the hypothesis 3 and shows a coefficient of 0,30.

This means that when individuals perceive the technology to be relatively free of cognitive effort, they will view it as releasing important cognitive resources that may be productively applied to other activities. In other words, they are more likely to perceive the technology to be useful in their work activities.

Social norms and management commitment are significantly associated with perceived usefulness (coeff = 0,26, p-value<0,05). This means that others, especially supervisors and mentors who can "press" workers in carrying out their tasks, affect individual's motivation to use the system but may not provide much support for how to use the system.

In predicting perceived ease of use, both in-degree centrality (coeff = 0,47 p<0,01) and individual variables (coeff = 0,25 p<0,05) are significant, while out-degree and Factor 3 don't, thus confirming hypothesis H7b, H7d, H7f for centrality and H4a, H4c e H4b for personal innovativeness and self-efficacy.

The high impact of in-degree centrality on ease of use means that people, who are extensively involved in relationships with others, have higher potentialities to have access to resources and thus to perceive as user-friendly a certain technology.

As stated above, personal innovativeness and self-efficacy exhibit strong effects on perceived ease of use. This means that the belief that one has, about the capability to perform a particular behaviour, reduces the perception of effort expectancy.

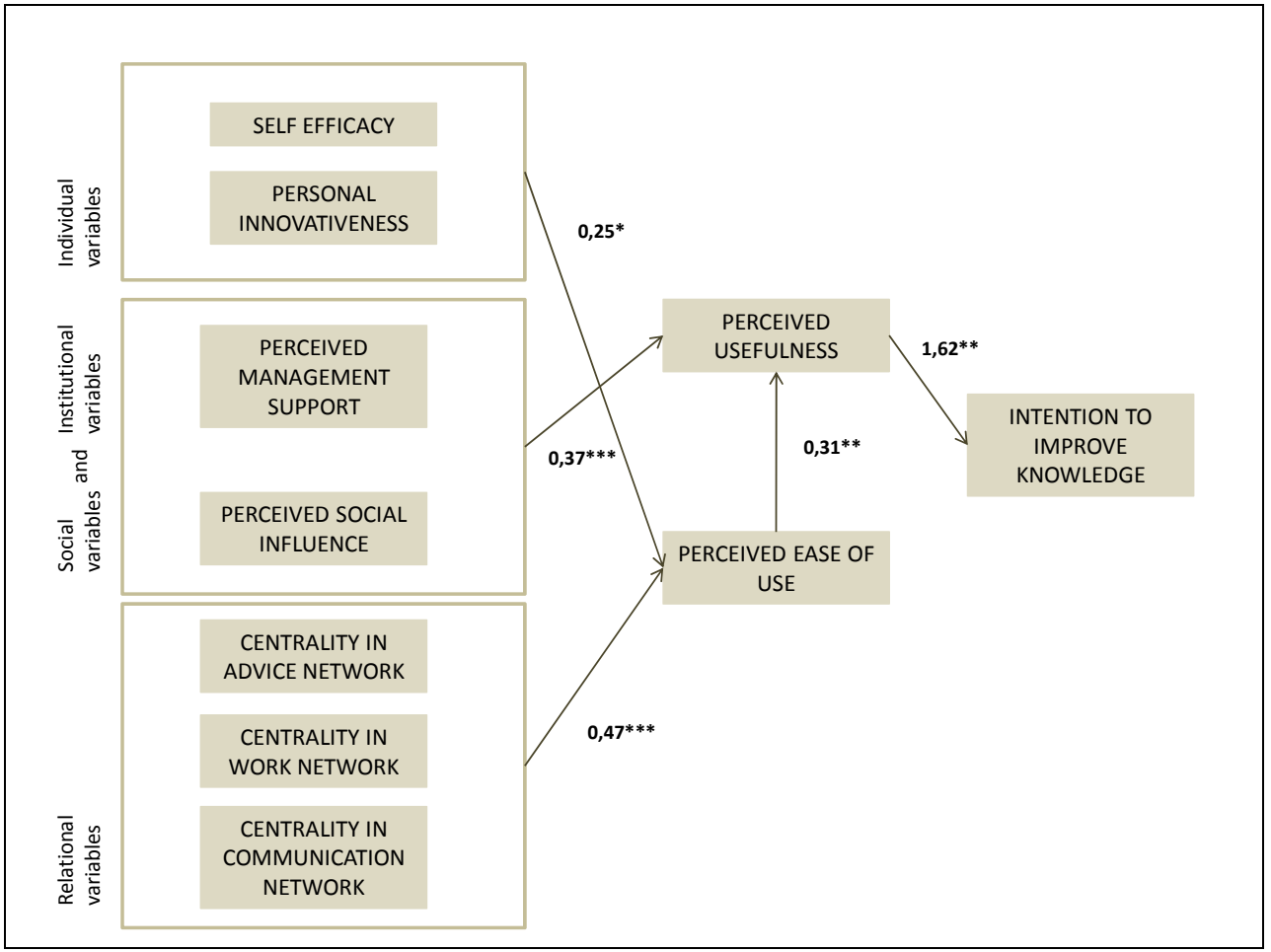
At the same time also the willingness to try any new technology is an important determinant because individuals, who have an innate propensity to be more innovative with information systems, are likely to be more inclined to experience hard circumstances.

Table n° 10 shows a synthesis of the analysis results, by highlighting supported and not supported hypothesis.

Table 10: Summary of hypothesis tests

HYPOTESIS	SUPPORT
H1: PU→ I	Yes
H1: PEOU → I	No
H3: PEOU → PU	Yes
H4a, H4b → PEOU	Yes
H4c, H4d → PU	No
H5a → PU	Yes
H5b → PEOU	No
H6a → PU	Yes
H6b → PEOU	No
H7a, H7c, H7e → PU	No
H7b, H7d, H7f → PEOU	Yes

Picture 8: Results



5.5 Relational variables analysis

The relational perspective adopted in the present study encourages the analysis of the relational variables by adopting social network analysis tools, in order to offer a more substantive and detailed investigation of the nature of the social relationships occurring in the organization.

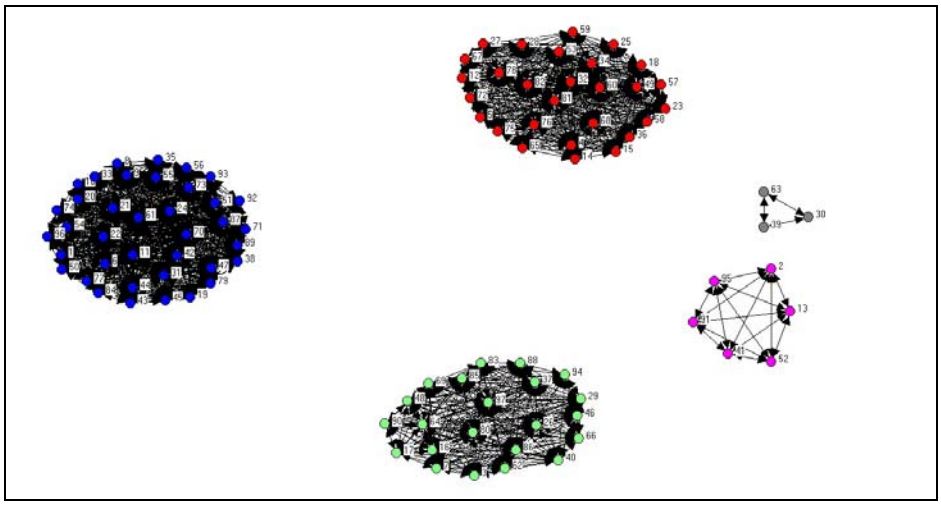
Using my data, I aimed also to assess whether and to what extent homophily drives social interaction. It has long been suggested that people who are similar are more likely to interact than people who have nothing in common (Monge and Contractor, 2003).

The aim of this analysis is to understand if relations of advice, work and ease of communication could be influenced by commonality among person based on their attributes. As stated on the paragraph 4.5.1, people who interact with each other for advice, job formalities or because easiness of communication seem to be similar for their proximity in terms of job function and work site. To confirm this evidence I created clusters based on attributes, by connecting people who are similar in terms of age, gender, education, building, and function.

As I did for other networks, I arranged data in 97 x 97 matrices. In each matrix cell X_{ij} corresponded to *i*'s similarity to *j* on the basis of their attributes. For example, if *i* is similar to *j* in terms of gender, then the cell X_{ij} in the gender matrix was coded as 1, otherwise Xij was coded as 0. For age, education, and gender I identified not only similarity but also differences.

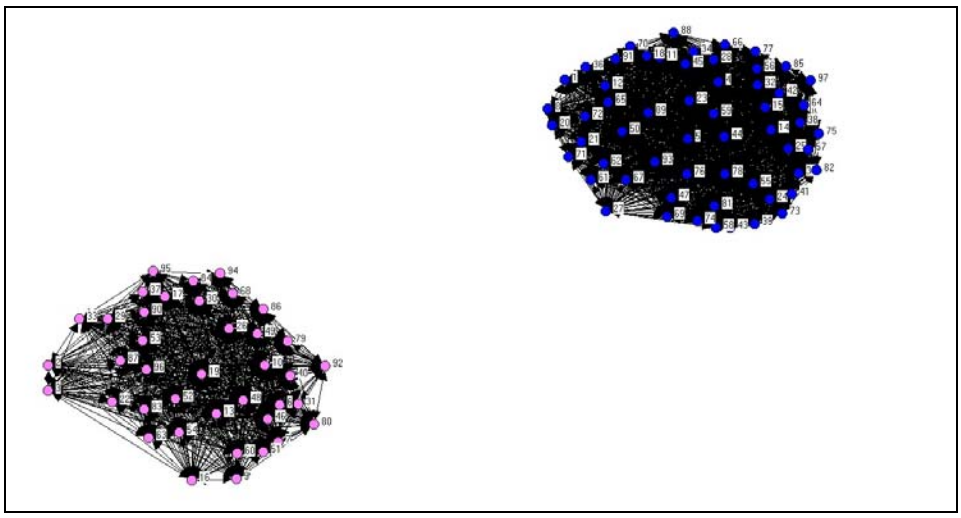
Figures 8, 9, 10, 11 and 12 show how nodes are tied on the basis of age, gender, education, building and function.

Figure 9: Similarity in age



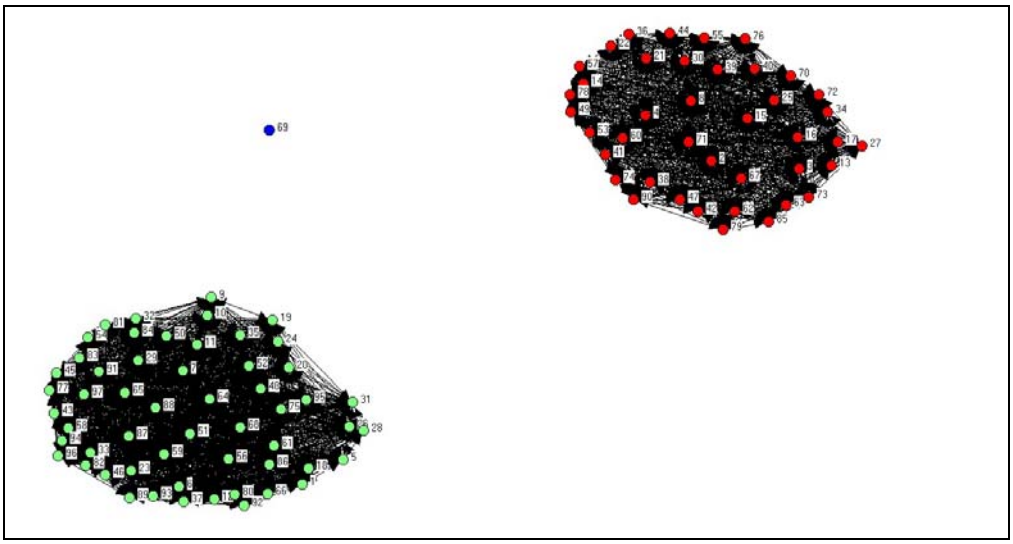
Red = 28-35; Blue = 36-40; Green = 41-45; Grey = 46-50; Pink = >50

Figure 10: Similarity in gender



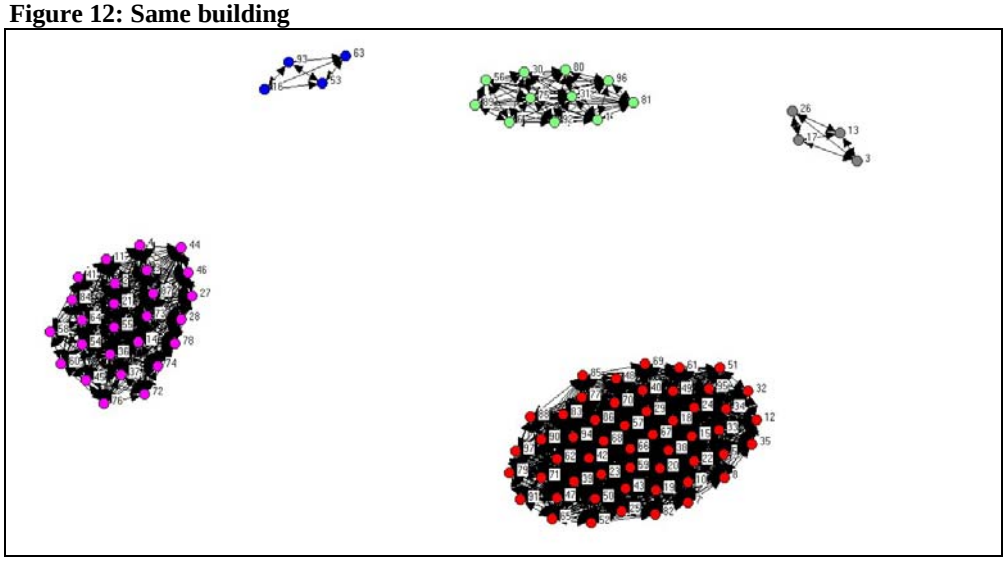
Blue = male; Pink = female

Figure 11: Similarity in education



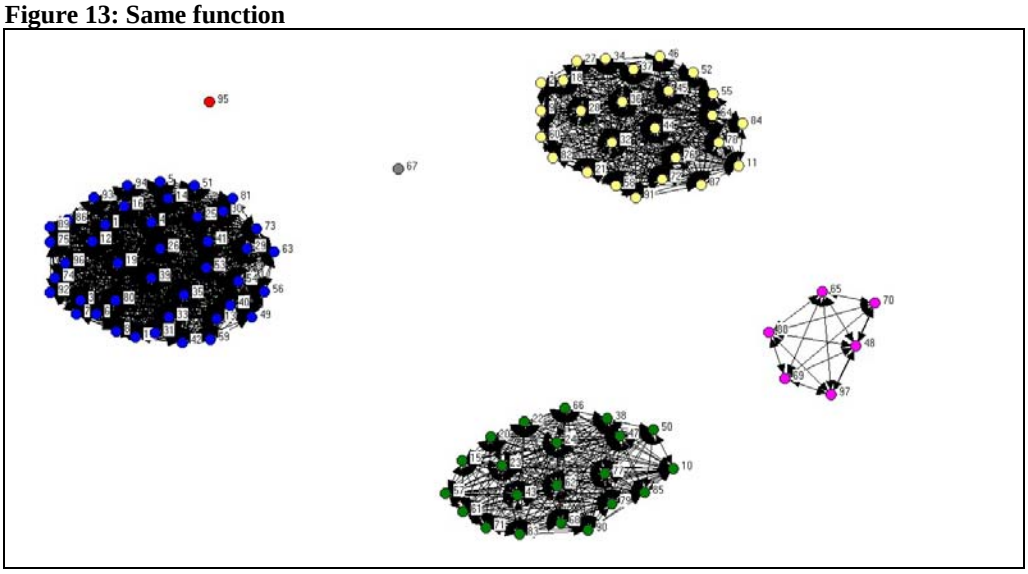
Red = Secondary School; Blue =Bachelor Degree ; Green = Master Degree

Figure 12: Same building



Red =Building A; Blue = Building B; Green = Building C; Grey = Building D; Pink = Building E.

Figure 13: Same function



Red =Function A; Blue = Function B; Yellow = Function C; Grey = Function D; Pink = Function E; Green = Function F

Once created the clusters, to determine the correlation between matrices, QAP (Quadratic Assignment Procedure) (Hubert & Schultz, 1976) correlation and regression have been used, computed in the UCINET program.

A QAP correlation is computed on these clusters and on the networks of advice, work relations and ease of communication.

Table 11 shows the results of the correlation. The correlation is significant with reference to advice, work relations and ease of communication, together with those of complementary attribute-based clusters as it was obvious. This means that those with whom everyone asks for advice are those with whom he has to relate to for work. Moreover, the probability to create ties based on shared mental models and thus the ease of communication is higher for people with whom everyone relates most.

Table 11: Correlation analysis SNA

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1. Same age	-										
2. Diff age	-0,688	-									
3. Same building	0,008	-0,015	-								
4. Same education	0,012	-0,016	0,021	-							
5. Diff education	-0,010	0,017	-0,029	-0,989	-						
6. Same gender	0,071	-0,117	0,041	-0,009	0,005	-					
7. Diff gender	-0,071	0,117	-0,041	0,009	-0,005	-1,000	-				
8. Same function	0,019	-0,023	0,123	-0,005	0,017	0,009	-0,009	-			
9. Advice	0,002	-0,010	0,074	0,001	0,001	0,010	-0,010	0,092	-		
10. Work relations	0,011	-0,001	0,042	0,002	0,000	0,012	-0,012	0,067	0,416	-	
11. Ease of communication	0,002	-0,007	0,073	0,014	-0,012	0,025	-0,025	0,089	0,578	0,533	-

According to Bühl and Zöfel (1995), the correlation coefficient can be interpreted as low if it has a value from 0,21 to 0,50. Thus, I can consider not so high the correlation between advice network and work relations network. To understand how these two networks influenced each other and test for alternative explanations, I run a regression analysis. As dependent variable I chose the advice network that is the variable that better explains individual's involvement in exchanging assistance with coworkers and engaging in mutual problem-solving. In fact, advice is usually given by more experienced actors to less experienced ones, a process that means the first affect the latter. Moreover I can't consider the workflow network as a dependent variable as these ties are formally predetermined. Therefore I assumed that the ease of communication network influences the advice network, stating that the higher the mutual understanding, the higher the individual tendency to relate to others for asking suggestions. The attribute-based clusters are considered as other independent variables.

The following table shows the results of the MRQAP.

Table 12: MRQAP

R-square	***Ad R-Square***	***Probability***	***Obs***
0,352	0,352	0,000	9312

Independent	***Coefficient***
INTERCEPT	0,004
DIFF AGE	-0,001
SAME AGE	-0,003
FUNCTION	0,008**
BUILDING	0,006*
GENDER	-0,001
EDUCATION	-0,001
WORK RELATIONS	0,17***
EASE COMMUNIC	0,55***

***<0,001 **<0,01 *<0,05

As expected, advice ties are highly influenced both by work relations network (coeff=0,17, p-value < 0,0001) and ease of communication network (coeff=0,55, p-value<0,0001). This means that people tend most to relate to and to ask for advice to those with whom they work together. In fact, they are aware of their knowledge and capabilities, speak the same language and share the same or complementary tasks.

An interesting result is also that physical proximity of nodes (coeff=0.006, p-value<0,01), i.e. nodes that are in the same building, as well as the functional proximity (coeff=0.008, p-value<0,05), i.e. nodes that work in the same organizational function, have a high influence on the creation of advice relations. This result means that belonging to the same division can encourage the exchange of advice for the same reasons explaining for work relations that is the opportunity to communicate to people who share the same mental models and similar tasks. Moreover, belonging to the same building can facilitate communication as well as informal meeting to exchange reciprocal suggestions.

CHAPTER 6: DISCUSSION AND CONCLUSIONS

Based on the paradigm of technology acceptance of information systems, this doctoral thesis investigates which variables affect user acceptance.

However computer acceptance is considered a mature research field (Venkatesh et al. 2003), in this paper I attempted to analyze it from a new perspective. Researchers have long suggested that social factors are critical for explaining users' behaviour towards technology, however they limited their examination looking at a normative perspective while this study provides evidence that individual technology acceptance is influenced by the individual's relational beliefs.

Therefore, when studying the determinants of individual behaviour towards technology it must be taken into account the fact that he individuals are embedded in a network of relations that could be a source of influence of their attitudes.

Based on this assumptions, I proposed a theoretical model in which dependent variable is the intention to improve the knowledge system. This choice and the rejection of the "classical" variable "intention to use" is due to the impossibility of managing a longitudinal study. Thus it seemed paradoxical to study the formation of attitude towards certain behaviour and the behaviour itself at the same time. Also the "traditional" "intention to use the system" seemed senseless because of the mandatory setting.

In the model I adopted the Davis' (Davis, 1989) core constructs, perceived usefulness and perceived ease of use, as direct determinants of intention to improve the system knowledge. Then I identified four classes of variables influencing these two constructs: individual, social, institutional and relational variables.

The model was tested by running a three stage least square regression, whose main relational-base results have been tested through the social network analysis support.

Findings show interesting implications. First, results highlight the strong link of individual perceived usefulness with the intention to improve the knowledge of SAP. Once the value and helpfulness of a system has been recognised, people tend to improve and refine the knowledge of its functions and every possible application both in terms of innovativeness and effectiveness. The influence of perceived ease of use seems to be irrelevant even if only from a direct viewpoint. In fact, results highlight the strong individuals link between perceived usefulness and ease of use, so practitioners, who might have been guided by previous TAM studies to underestimate the importance of perceived ease of use, should reconsider the extent to which perceived ease of use indirectly affects the individual behaviour.

Second, another important result is revealed by the significant impact of social variables and institutional variables on perceived usefulness. Analyses show that individuals need an institutional support for their understanding of technology usefulness.

As stated above in this work, several theories suggest that social influence is crucial in shaping user behaviour. From social psychological and economic perspectives, the most common variable used to describe social influence is the so called "social norms". In the present study social influence, considered in the sense described above, i.e. as the perceived social pressure to perform or not perform the behaviour (Ajzen 1991; p. 188), shows a strong effect only on perceived usefulness while doesn't seems to affect perceived ease of use. In other words, the "stress" people have that other important to them expect they to use SAP, and the persuasion that using SAP improve their image and prestige, increase the perception of the system usefulness, without showing the practical implications that can derive from its use.

Third, practitioners also have to consider that perceived ease of use effects is dependent on individual features and social ties. Self-efficacy and personal innovativeness are constructs of interest to both researchers and IT professionals because of their strength in motivating end-users as well as their ability to be enhanced, particularly through training and experience (Downey 2006). These variables have a direct impact on perceived ease

of use thus confirming that when an individual is self confident but also an innovator, could perceive a technology as user-friendly more than anyone else who is more reluctant to change.

Moreover, it must be taken into account that, during the adoption of a technology, individuals identify their channels in order to understand the complex and misunderstood functions of the technology and how to manage it. In such situation, an actor who has a central position is more exposed to the organization's belief towards technology. Because of advice ties depend on work relations but also on spatial and "functional" proximity among nodes, it is important to facilitate spontaneous and informal face to face communication by arranging similar people close to one another. These patterns of communication encourage also the development of shared language that is a necessary condition to enhance the exchange process among individuals. In turn, the ability to exchange information among members allows sharing positive (or negative) beliefs about new systems. Therefore, these results confirm the central assumption of social information processing theory, according to which individuals must be proximate to the attitudes, information or behaviour of others to be exposed to social information and to their influence.

6.1 Managerial implications

According to Venkatesh and Davis (2000), an investment in technology is inherently risky because potential performance gains are often obstructed by users' unwillingness to accept and use it.

Given this context, my study offers several practical implications for firms that have to manage this issue and that are going to introduce a new information system.

In fact, implementation of a new technology is not only related to technical or project management issues, but also to social aspect that involves users. In particular,

management has to monitor and take into account rumours related to technology in order to isolate a possible negative domino effect.

The results show that relational variables explain a high variance. Monitoring interactions in an organizational social system, especially during the early stages of a system implementation, makes early detection and correction of difficulties possible.

It must also be taken into account that when, for instance, advertising, marketing, or implementing new systems, IT providers might find it beneficial to address messages to pivotal people in the organizational network, that means addressing it to innovative and self confident individuals but also central nodes. Thus, specific attention must be devoted to fostering the development of profitable relationships in order to favour the introduction of a new technology. This issue can be achieved for instance by grouping people in work teams whose leaders are assigned supporting and fostering roles.

On the other side, managers have to be able to leverage on those dimensions of social capital which enhance the development of positive beliefs toward technology. So it must be taken into account that the role of organizational support is important to facilitate change management process in which users are involved.

6.2 Limitations

My data are cross-sectional, so future research should adopt a longitudinal research design in order to fully establish the causality relationship from independent to dependent variables. This approach could be interesting especially in reference with relational data thus to analyse how the evolution of relations may affect and change individual acceptance of technology.

Therefore, the present study adopts subjective measures, by asking individual perception to questionnaire recipients; although it is common in acceptance literature to assess both

perception of ease of use and usefulness and their antecedent, it should be considered more objective variables.

This work and its relational perspective are new in the field of technology acceptance theory and needs to be tested and validated.

APPENDIX 1 - Descriptive network statistics

	Definition	Advice		Work relations		Ease of communication	
Density (st.dev)	Proportion of actual connections over theoretical maximum number of connections	0.0103 (0.1010)		0.0077 (0.0876)		0.0083 (0.0906)	
Average degree (st.dev)	Average number of edges incident with nodes	Out 0.990 (1.223)	In 0.990 (1.738)	Out 0.794 (1.015)	In 0.794 (1.443)	Out 0.742 (1.058)	In 0.742 (1.254)
Max degree	Maximum observed number of network connection	5.000	10.000	4.000	7.000	5.000	6.000
Number of nodes	Number of actors in the sample	97		97		97	

APPENDIX 2 - Questionnaire

1. When a new technology is introduces into your organization, you use it to work:

- If there is no one close to you who tell you how to do

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

- If you have a handbook

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

- If you haven't just used before something comparable to it

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

- Even if you don't know it

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

- Even if you haven't attended a training program

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

2. When a new technology is introduces into your organization, you are usually the first to try out the new IS among your friends and colleagues.

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

3. If I heard about a new IS, I would look for ways to experiment it

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

4. Do you use SAP?

☐ *Yes* ☐ *No*

5. Why do you use SAP? Please, indicate your degree of agreement or disagreement about the following statements:

- Because it is binding for your job

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

- Because it improves my job performance

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

- Because it enables me to accomplish my tasks more quickly

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

6. Do you think to know all the SAP features related to your job?

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

7. Are you comfortable with SAP?

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

8. Your colleagues and your supervisor expect you to use SAP

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

9. People in my organization who use the system have a high profile

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

10. The management is committed to supporting your efforts in using SAP

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

11. To whom and how frequently do you ask for advices about how to use SAP to accomplish your work?

☐ ***Person 1***	☐ ***Person 2***	☐ ***Person 3***
• *Annually*	• *Annually*	• *Annually*
• *Monthly*	• *Monthly*	• *Monthly*
• *Weekly*	• *Weekly*	• *Weekly*
• *Daily*	• *Daily*	• *Daily*

12. With whom do you relate to perform your tasks which are SAP use-based?

☐ ***Person 1***	☐ ***Person 2***	☐ ***Person 3***
• *Annually*	• *Annually*	• *Annually*
• *Monthly*	• *Monthly*	• *Monthly*
• *Weekly*	• *Weekly*	• *Weekly*
• *Daily*	• *Daily*	• *Daily*

13. With whom is it easer for you to relate to discuss problems or task which are SAP-based.

☐ ***Person 1***	☐ ***Person 2***	☐ ***Person 3***
• *Annually*	• *Annually*	• *Annually*
• *Monthly*	• *Monthly*	• *Monthly*
• *Weekly*	• *Weekly*	• *Weekly*
• *Daily*	• *Daily*	• *Daily*

14. How often do you use SAP?

☐ *Annually* ☐ *Monthly* ☐ *Weekly* ☐ *Daily*

15. Do you intend to intensify the knowledge of SAP because you think it is a useful tool for your productivity?

☐ *Strongly disagree* ☐ *Disagree* ☐ *Neither agree nor disagree*
☐ *Agree* ☐ *Strongly agree*

APPENDIX 3 – Graphical representation of the networks

Advice network

Figure 13: Advice and gender

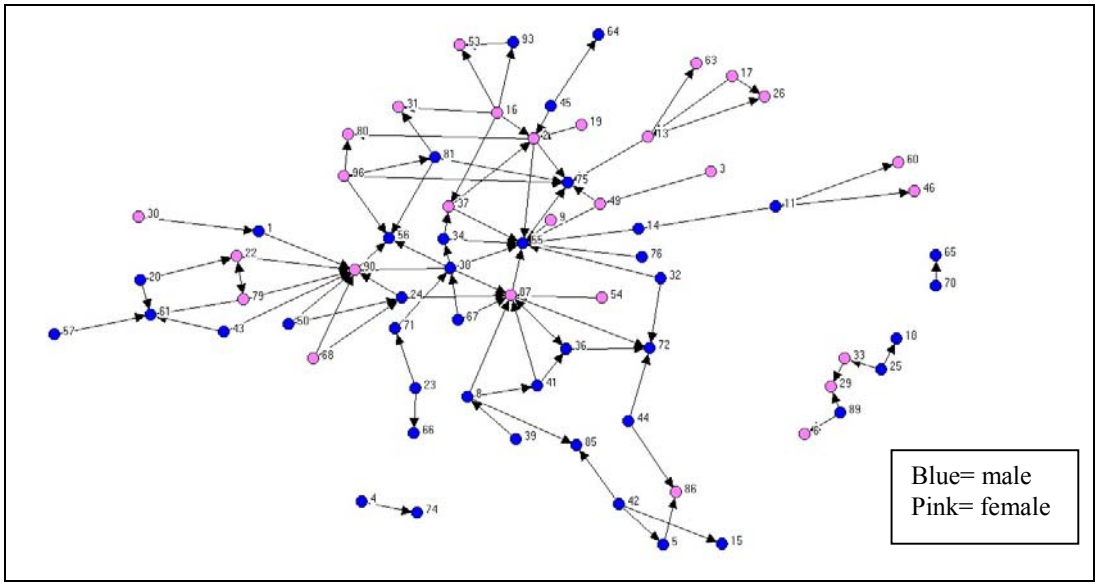


Figure 14: Advice and education

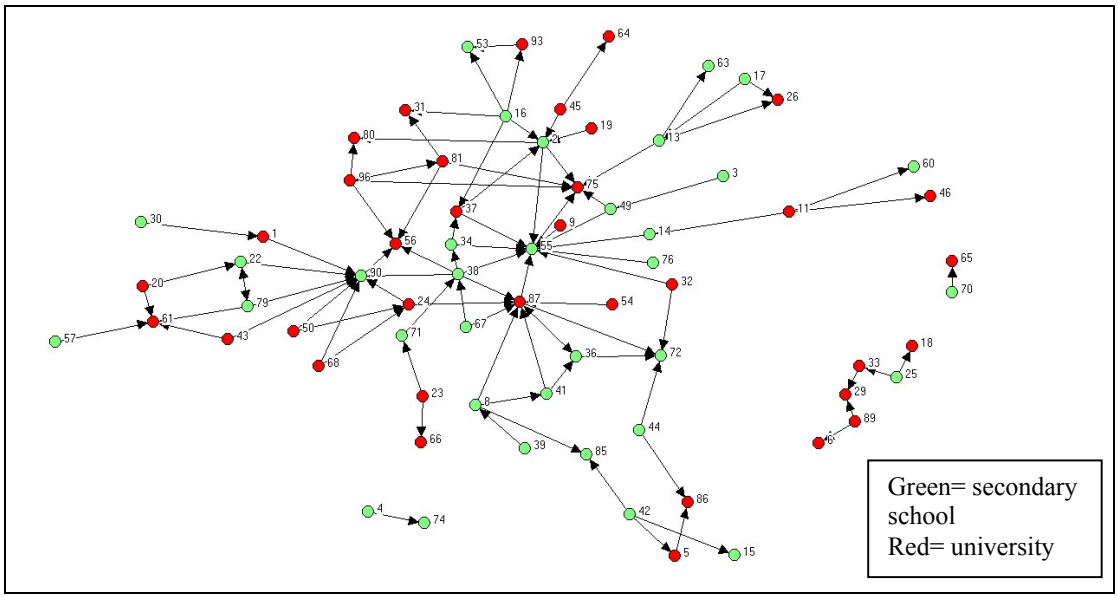


Figure 15: Advice and building

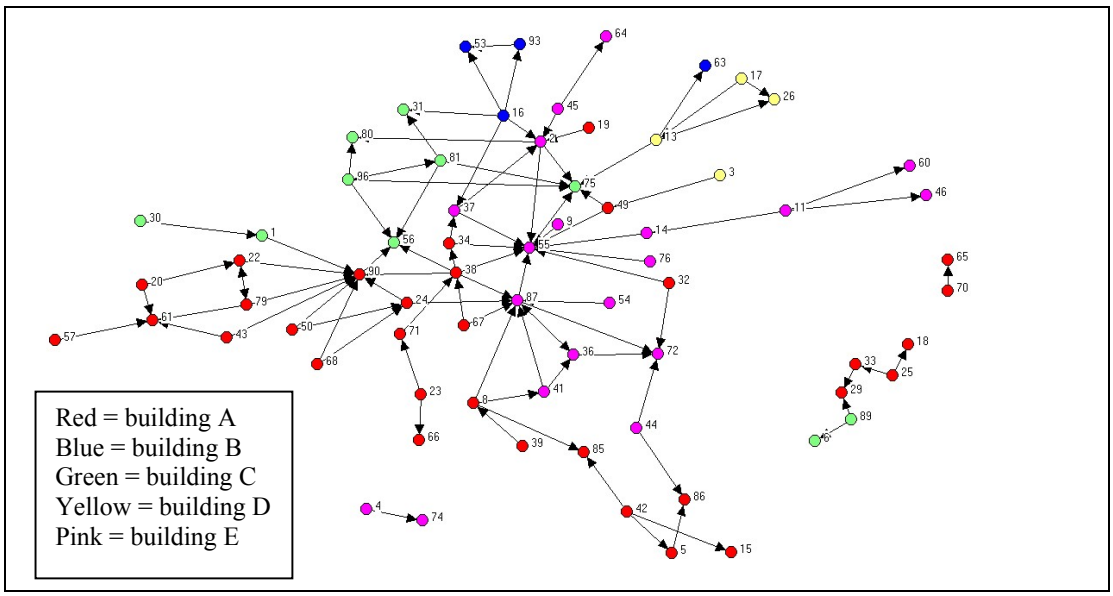
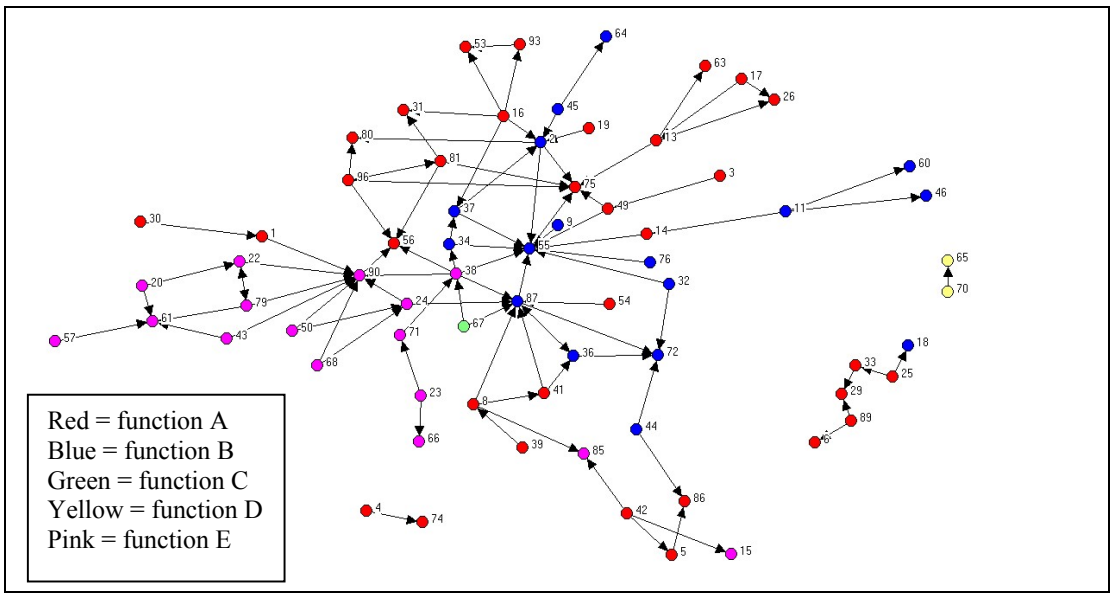


Figure 16: Advice and organizational function



Work-based network

Figure 17: Work relations and gender

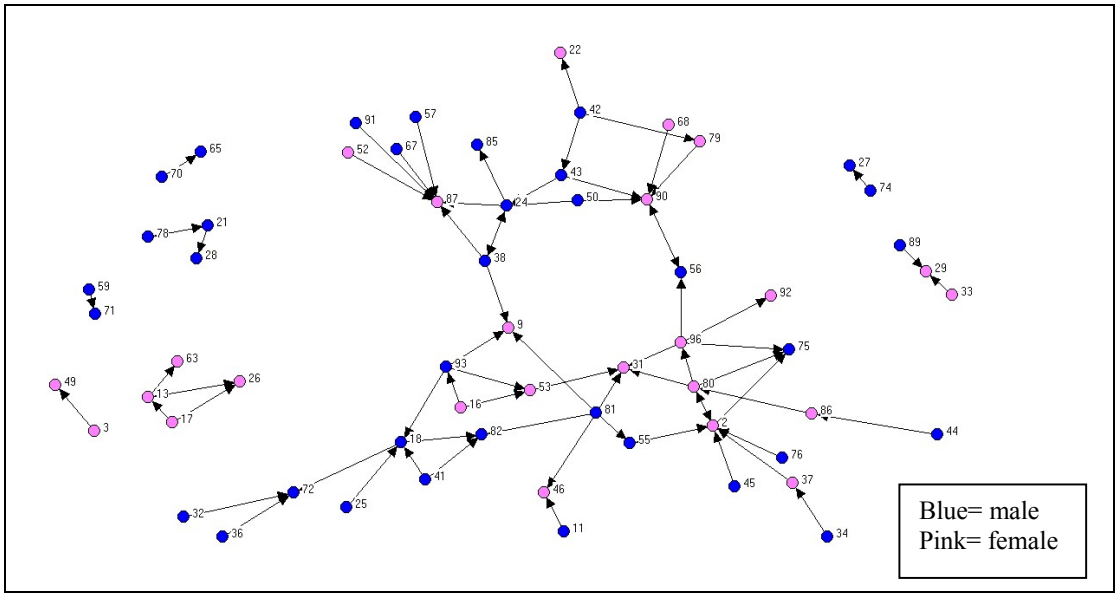


Figure 18: Work relations and education

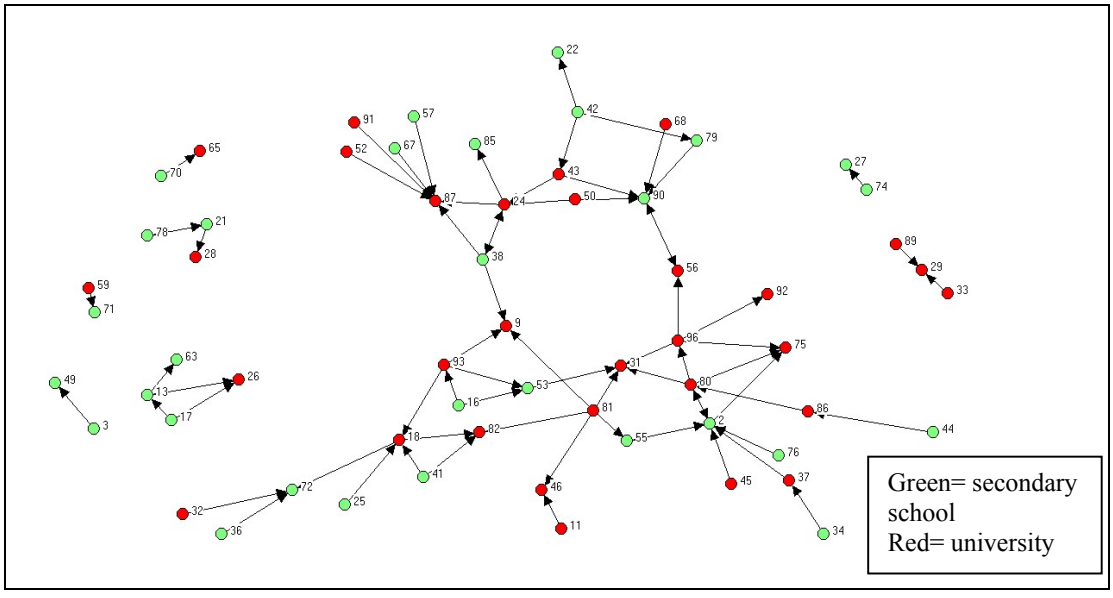


Figure 19: Work relations and building

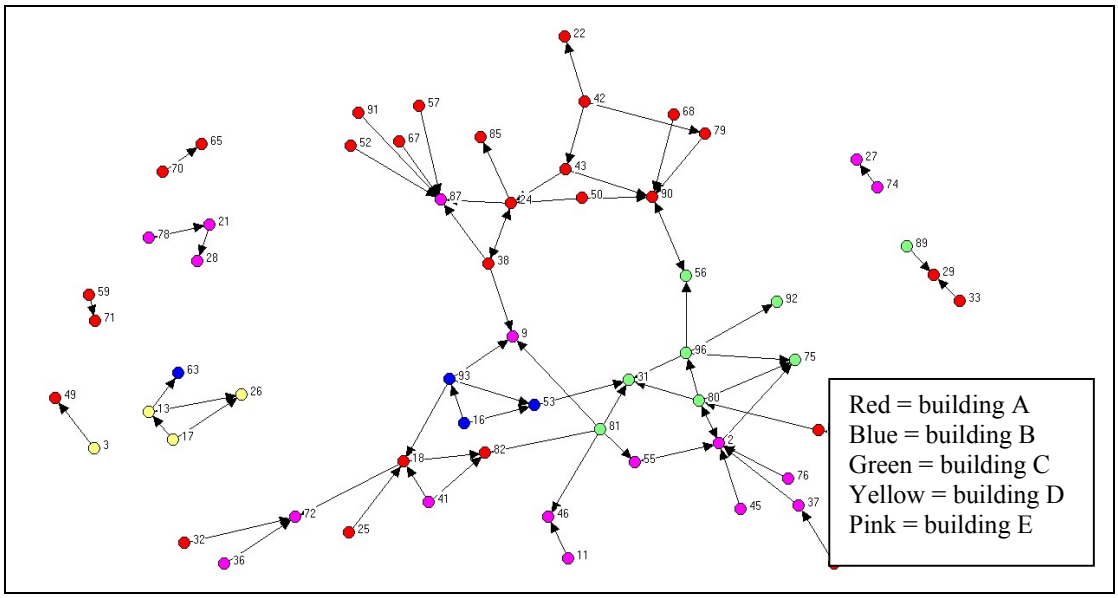
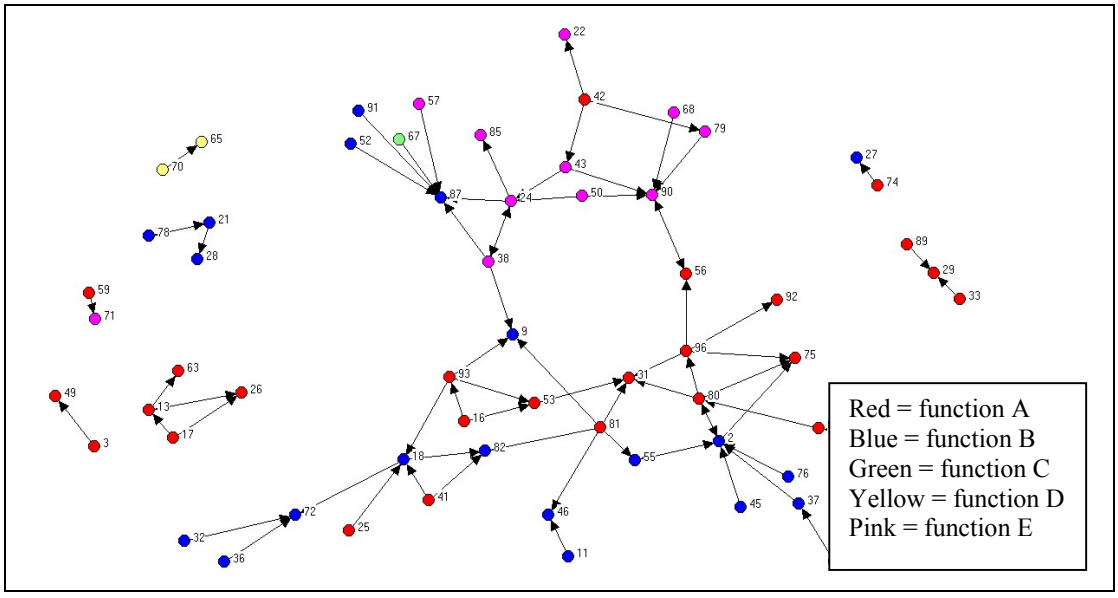


Figure 20: Work relations and organizational function



Ease of communication network

Figure 21: Ease of communication and gender

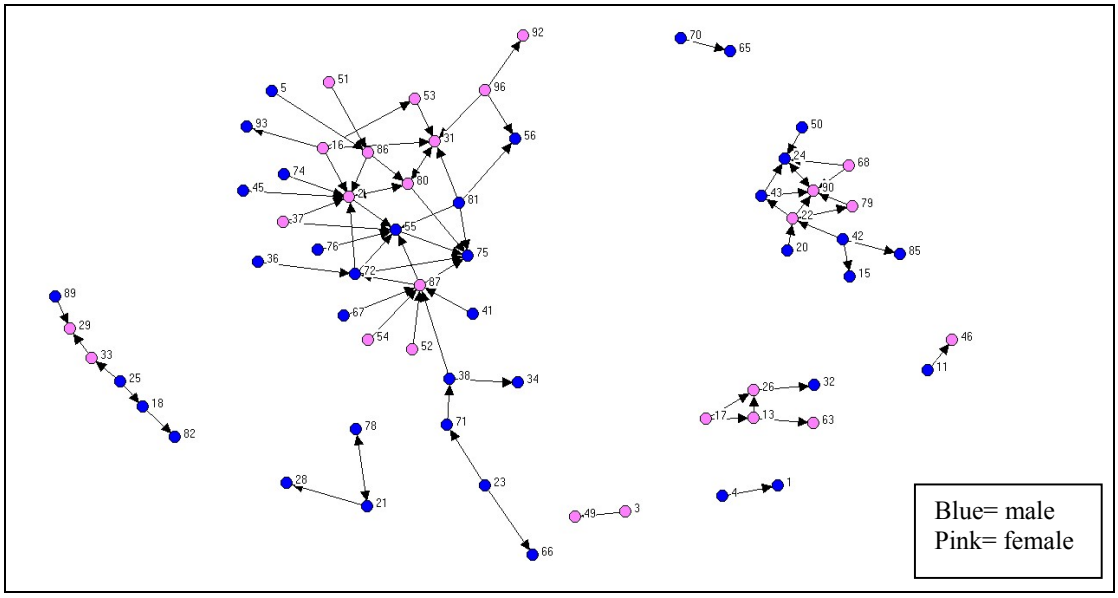


Figure 12: Ease of communication and education

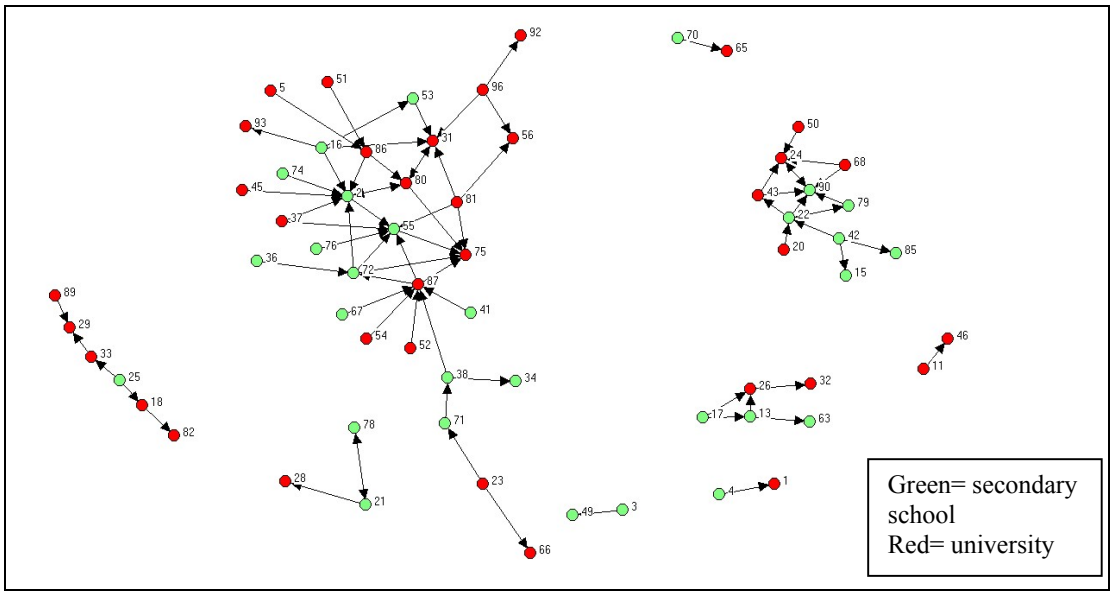


Figure 23: Ease of communication and building

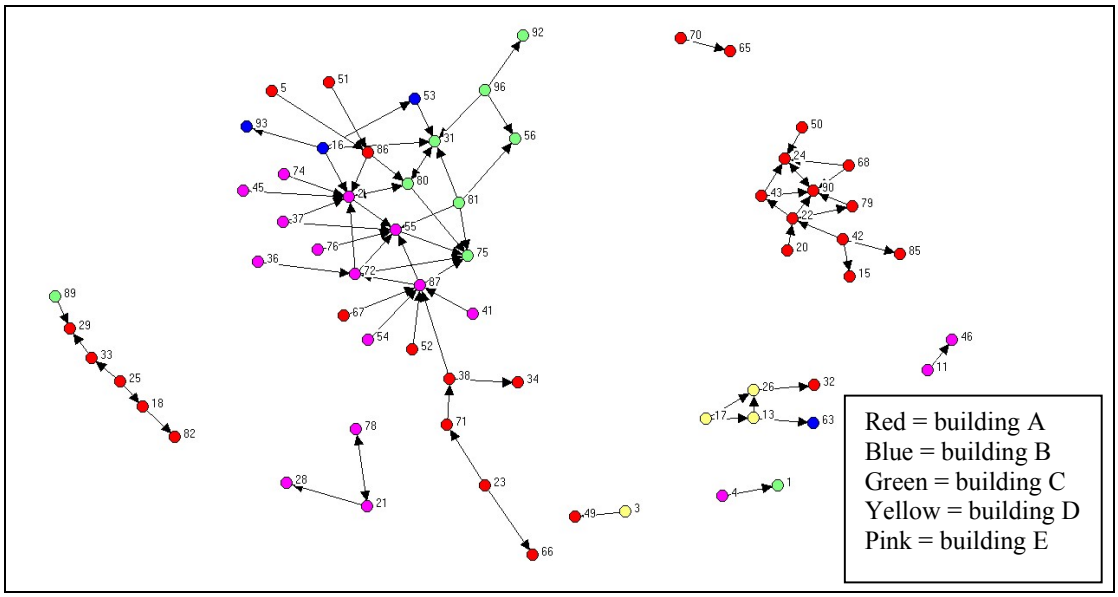
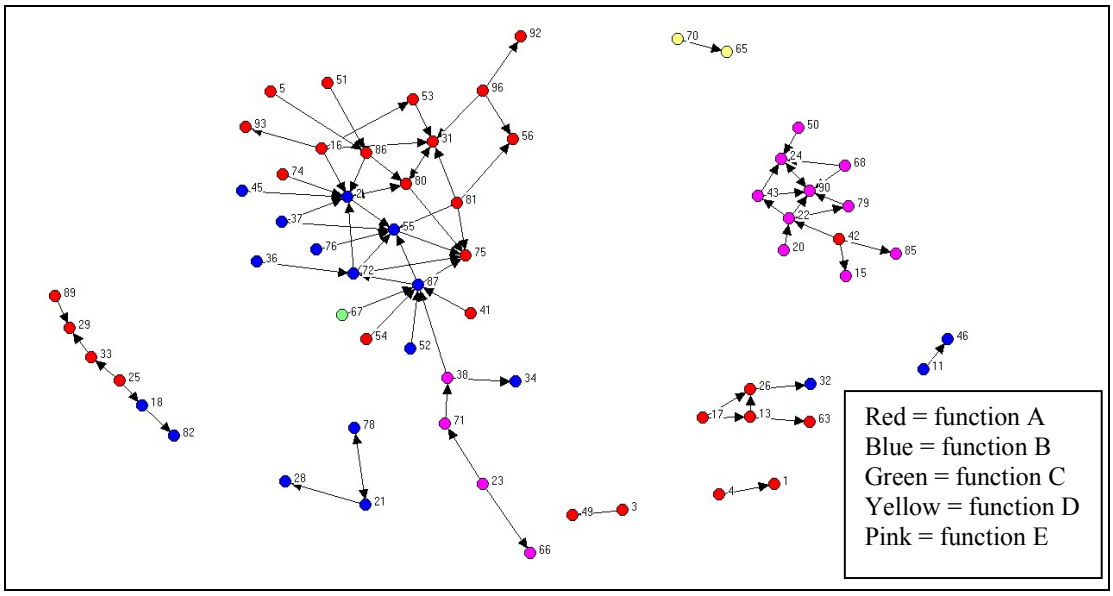


Figure 24: Ease of communication and organizational function



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